AD-A145 943 OFFICE AUTOMATION: OFFICE OF THE ASSISTANT CHIEF OF ENGINEERS(U) CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL R L LAPP ET AL. SEP 84 1/1

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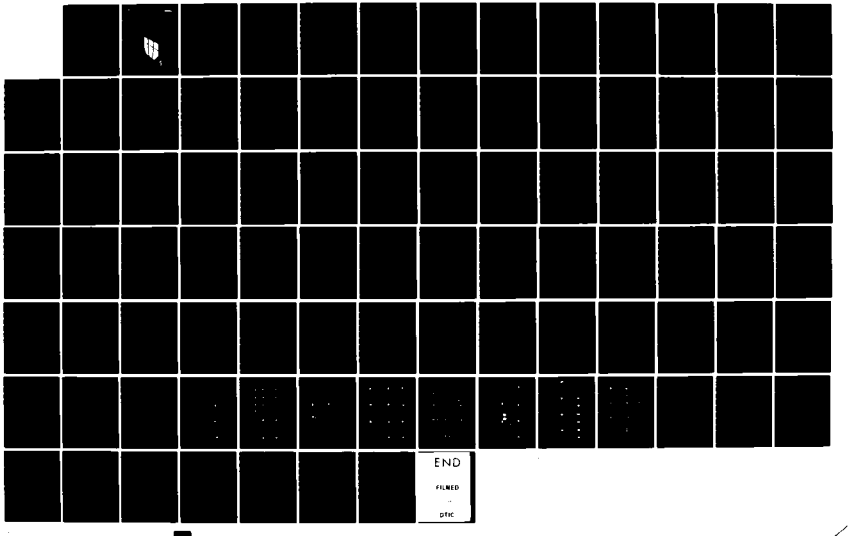
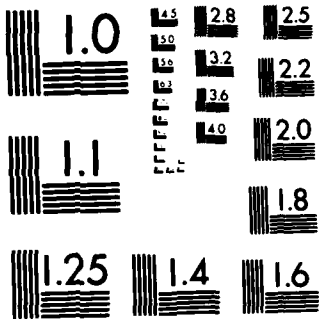
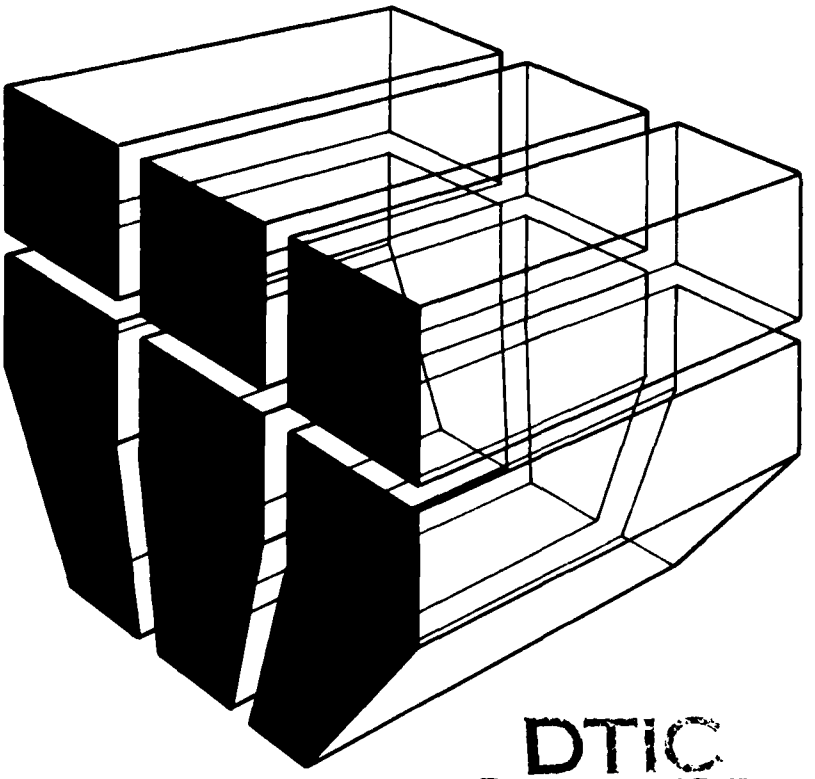




US Army Corps
of Engineers
Construction Engineering
Research Laboratory

TECHNICAL REPORT P-167
September 1984
Military Construction Program Management/Decision Support System

OFFICE AUTOMATION: OFFICE OF THE ASSISTANT CHIEF OF ENGINEERS



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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CERL-TR-P-167	2. GOVT ACCESSION NO. AD-A145 993	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* OFFICE AUTOMATION: OFFICE OF THE ASSISTANT CHIEF OF ENGINEERS		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Roger L. Lapp, Janet R. Randle, Steven D. Friederich, Frank J. Mabry, Arthur B. Baskin, Simon S. Kim, Alan W. Moore		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. ARMY CONSTRUCTION ENGINEERING RESEARCH LABORATORY P.O. BOX 4005, CHAMPAIGN, IL 61820		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 4A162731AT41-A-063
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE September 1984 13. NUMBER OF PAGES 85
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Copies are available from the National Technical Information Service
Springfield, VA 22161

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Office of the Assistant Chief of Engineers
office buildings
office equipment and supplies
automation
computer applications

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Results are presented on an investigation to determine the immediate and long-range office automation requirements of the Office of the Assistant Chief of Engineers (OACE), U.S. Army Corps of Engineers (USACE). OACE, within the Office of the Chief of Engineers (OCE), employs approximately 230 persons in planning, programming, and budgeting for Army military construction (including family housing) and for operating and maintaining constructed facilities.

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OACE is an increasingly intensive user of computer technology. Although 54 workstations for accessing various remote data systems and for word processing were in place at the beginning of the study, it was known that actual needs greatly exceeded existing capabilities. Individual offices within the OACE previously were responsible for meeting their own office automation requirements. However, as the level of automation increased, it became evident that an overall plan was required to fully integrate the offices and provide them system capabilities which they could not otherwise justify. This would provide quality computer hardware, communications, and software technology at minimal cost.

It was found that the actual need was about 139 workstations, of which 75 were professional (personal computer), 33 were word processing, and 31 were unintelligent terminals. The users expressed a universal need for access to other OACE offices' data and to remote data systems. To meet this need, high-speed communications lines would be required to manage the large data traffic rapidly. These lines would link OACE offices in the Pentagon and the Pulaski Building with each other and with their primary data center in Dallas, TX. Also, a high-speed laser printer would be required in each building to handle large-volume, hard-copy output requirements. In addition, several small and large plotters, color graphic plotters, portable personal computers, and portable unintelligent terminals would be required. Each personal computer would require word processing, data base management, spread sheet, graphics, time management, and operating system software. Supplies of less frequently used software (e.g., network analysis, statistics, and BASIC interpreters) would be available on an office basis. Word processing software would be compatible with personal computer software.

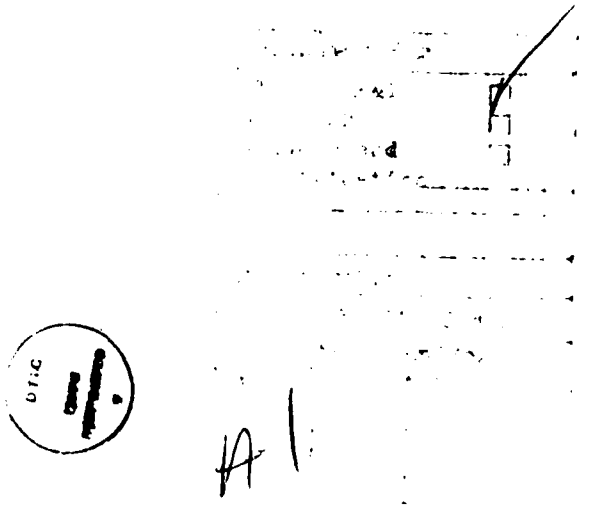
Although this report is targeted for OACE, it will be useful to any organization contemplating large-scale office automation. The report describes total system design considerations, development of requirements, full acquisition and maintenance costs, training requirements and training costs, assessment and comparison of alternative individual components and overall system performance, and phased implementation.

FOREWORD

This investigation was performed by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) for the Assistant Chief of Engineers, Office of the Chief of Engineers (OCE), under RDTE Project 4A162731AT41, "Military Facilities Engineering Technology"; Task A, "Facilities Planning and Design"; Work Unit 063, "Military Construction Program Management/Decision Support System." The applicable Requirement Code is STO 81-8:6. The OCE Technical Monitor was William C. Rackley, DAEN-ZCF-M.

This work was performed by the Facility Systems (FS) Division of USA-CERL. Edward A. Lotz is Chief of FS.

COL Paul J. Theuer is Commander and Director of USA-CERL, and Dr. L. R. Shaffer is Technical Director.



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OFFICE AUTOMATION: OFFICE OF THE
ASSISTANT CHIEF OF ENGINEERS

1 INTRODUCTION

Background

As a branch of the U.S. Army Corps of Engineers (USACE) Office of the Chief of Engineers (OCE), the Office of the Assistant Chief of Engineers (OACE) has extensive responsibilities. Every year involves multiyear programs management, and each programmed year amounts to approximately $6 billion. An immense amount of data flows within, to, and from the office in its interactions with the entire Army, Department of the Army (DA) headquarters other military services, Department of Defense (DOD), and Congress. The scope of operation is evident from the following list of Assistant Chief of Engineers' duties.[1] The entire OACE staff assists in performing these duties.

> The Assistant Chief of Engineers (ACE) directs and integrates the Army's three facility accounts (Military Construction Army (MCA), Army Family Housing (AFH), and Real Property Maintenance Activity (RPMA)). Develops the requirements and programming aspects of these three accounts. Represents the Appropriation and Program Director of MCA and AFH Programs. Is the Program Director for the RPMA Program, Program Element Director for RPMA program elements, and functional manager of the installation restoration and bachelor furnishings accounts of BASOPS. Represents the Appropriation and Program Element Director of the DOD Homeowners Assistance Fund and Wildlife Conservation Fund. Chairs the Stationing and Installation Planning Committee (SIPC). Is a member of the Program Budget Committee, the Strategy and Planning Committee, and the Army Subsistence Committee. Maintains overview of the military construction programs for the Reserve Components. Executes primary DA Staff responsibility for installations planning and utilization which includes managing the lifecycle of Army Real Property. DA proponent for assessing facilities impacts of Army stationing actions. DA proponent for Army Stationing and Installation Plan (ASIP). Plans and executes the Army base development program by establishing and disseminating technical policies, criteria, and procedures to all Major Army Commands (MACOMs). Represents the Chief of Engineers (COE) in his absence as Army Systems Acquisition Review Council (ASARC) special member and provides Army Staff (ARSTAF) interface on all force modernization activities. As Topographer of the Army, supports Assistant Chief of Staff for Intelligence/ Deputy Chief of Staff for Logistics (ACSI/DCSOPS) in the execution of topographic functions and assessment of Defense Mapping Agency responsiveness to Army requirements. Develops

[1]Office Memorandum (OM) 10-1-1, Organization and Functions, Office of the Chief of Engineers/Headquarters, United States Army Corps of Engineers (October 1982).

and manages the Army Facilities Components System (AFCS). Participates with Directorate of Research and Development (DAEN-RD) in defining for COE approval the OCE Research and Development (R&D) major goals to support Army topographic, military engineering, AFCS, environmental programs, and base development functions. Provides advice as required to elements of the DA Staff on military engineering matters. Executes primary DA Staff responsibility for the Army Environmental Program. Coordinates ARSTAF actions in the implementation of the Army Environmental Program. Develops and manages the Army Facilities Energy Program. Serves as central OCE point of contact to elements of the DA General Staff on matters of real estate and real property maintenance activities. Represents COE in his absence as member of the Select Committee (SELCOM), the Engineer Center Team, the Materiel Acquisition Review Committee, and the Study Coordinating Committee. The ACE is assisted by the Deputy ACE for Facilities and Housing; the Deputy ACE for Planning, Programming and Congressional Affairs; the Executive Director; the Construction Programming, Facilities Engineering, Army Housing Management, Installation Planning, Military Engineering and Topography, and Environmental Divisions; and the Real Property Management System (RPMS) Integration and Planning Office. In addition, the ACE has staff supervision of the Facilities Engineering Support Agency (FESA), a Corps of Engineers field operating agency.

OACE has used computer technology for many years at an increasing rate. To meet the functional managers' operational needs, OACE has not only accessed data systems maintained by others, but has fostered such systems as AMPRS II (successor to the Automated Military Progress Reporting System [AMPRS]) and the Environmental Technical Information System (ETIS). In addition, OACE has taken the lead in sponsoring major data systems essential to its own mission, such as the DD Form 1391 Processor; the Construction Appropriations, Programming, Control, and Execution System (CAPCES); the Environmental Early Warning System (EEWS); the Army Criteria Tracking System (ACTS); the Stationing Analysis Model (SAM) (successor to the Army Stationing Installation Plan [ASIP] and the Directed Stationing System [DSS]); and the Data Traffic Management System (DTMS). Apart from accessing centralized data systems, virtually all clerical support has become heavily involved in word processing, primarily using NBI System 3000 procedures.

The level of involvement had progressed to a stage at which the magnitude of computer processing on remote data systems was so immense that, in January 1980, OACE decided to let a fixed-price, competitive contract for large-volume, long-term, worldwide computer hardware/software/communications support services. This contract produced a support service called the Programming, Administration, and Execution (PAX) System. PAX supports the DD Form 1391 Processor, CAPCES, AMPRS II, DTMS, other data systems, and provides many other services, one of the more notable being PAXMAIL. The contract was awarded in February 1982 to Tymshare, Inc., with the principal data center in Dallas, TX. These communications link USACE worldwide offices with each other and with all Army offices, MACOMs, and installations engaged in facility engineering.

At the beginning of this study, OACE's 54 workstations were used intensively and it was perceived that more were needed immediately. Since unorganized addition of personal computers, word processors, and unintelligent terminals would not solve most inherent problems, the need was seen for a plan of integrated, orderly growth.

Objective

The purpose of this study was to determine immediate and long-range office automation (OA) requirements for OACE and to use the results to implement a flexible OA architecture that allows for future growth.

Approach

The approach consists of:

1. Collecting requirements by interviewing key personnel and enough others to cross-check requirements for accuracy

2. Performing a physical inventory of existing equipment and checking equipment usage to verify that stated requirements were valid

3. Investigating the current technology, technological trends, technology cost, and cost trends, to determine how the requirements can best be met (analysis of alternatives) with respect to function, cost, and future expandability

4. Organizing the data for intelligibility, and deciding how to best proceed.

Scope

This study covers a plan for immediate and long-range OA requirements at OACE. Immediate requirements include:

1. Computer technology (hardware, software, and communications) needed within OACE to accomplish its mission

2. Improvement of local and remote communications

3. Equipment maintenance

4. A comprehensive plan to implement 1 through 3 above.

Future OA requirements include:

1. Increased effectiveness of resource management within OACE

2. OA system export to field agencies

3. Established guidelines for other agencies in planning, installing, and using automation in their respective offices.

2 THE OA PROBLEM AND CONCEPT FOR SOLUTION

Problem Identification

OACE employees numbered approximately 232 (227 Government, 5 contractor) in May 1983. Of these employees, 97 worked in the Pentagon in Arlington, VA; 135 worked at the Pulaski Building in Washington, D.C. Table 1 shows OACE's organization and strength. The order of offices shown in the table is the order used throughout this report to promote a visual image of spatial location. The table shows that one office, DAEN-ZCP, is located in both the Pentagon and the Pulaski Building (as of May 1983).

When the study began, OACE had already identified general problems and possible solutions (Table 2). Thus, the study was concerned with implementing the solutions--describing, quantifying, estimating cost, selecting, and timing of hardware, software, communications, training, and other aspects--the gathering and sifting of myriad facts leading to a rational plan. It was presumed that any plan would embrace the OACE mission and be user-responsive, relatively simple, cost-effective, rapidly implemented, easily maintained, reliable, state-of-the-art, and readily adaptable to technological changes (both Government and industry) without causing undue office turmoil.

OA Solution Concept

There are no standard concepts, definitions, or approaches for OA operations. Although many companies are in the OA business, no clear-cut standard procedures have evolved. The concept and approach depend on the requirements, opportunities, available resources, and transitional difficulties involved with OA. A conceptual OA framework for OACE was established at the outset of the study.

The Premise

Through preliminary interviews with OACE staff, a specific guideline was established: OACE office automation must be end-user oriented, that is, the automation tools must be simple to use (menu driven).

Definition

OACE's OA project was named "ACE Automated Office System (AAUTOS)" at the beginning of the study through meetings with end-users and supervisors. Requirements for the proposed system were combined to define its essential characteristics. The system must:

1. Be flexible and expandable, i.e., the system can be upgraded to take advantage of present and future technology

2. Have a large supply of good, relatively inexpensive software

3. Have reliable vendors to supply hardware and maintenance

4. Require minimal training

Table 1

OACE Organization

Symbol	Office Title	No. of Personnel
Pentagon		
DAEN-ZCZ	Assistant Chief of Engineers	9
DAEN-ZCE	Army Environmental Office	10
DAEN-ZCM	Military Engineering and Topography Division	18
DAEN-ZCM-W	War Plans and Exercises Team	
DAEN-ZCM-M	Materiel Acquisiton and Base Development Team	
DAEN-ZCM-T	Topography Team	
DAEN-ZCA	Office of Management and Staff Support	3
DAEN-ZCI	Installations Planning Division	27
DAEN-ZCI-A	Installations Assessment Branch	
DAEN-ZCI-F	Force Assessment Branch	
DAEN-ZCI-S	Systems Development Branch	
DAEN-ZCR	RPMS Integration and Planning Office	6
DAEN-ZCP	Construction Programming Division	24
DAEN-ZCP-R	MCP Requirements Branch	
DAEN-ZCP-U	Housing and Urgent Requirements Branch	
DAEN-ZCP-C	Congressional/Budget Branch	
Pentagon total		97
Pulaski		
DAEN-ZCP	Construction Programming Division (Cont'd)	25
DAEN-ZCP-M	MILCON Management Branch	
DAEN-ZCF	Facilities Engineering Division	60
DAEN-ZCF-R	RPMA Resources Branch	
DAEN-ZCF-M	RPMA Management Branch	
DAEN-ZCF-U	RPMA Utilities Branch	
DAEN-ZCF-B	RPMA Buildings and Grounds Branch	
DAEN-ZCH	Army Housing Management Division	50
DAEN-ZCH-R	Resources Branch	
DAEN-ZCH-M	Management Branch	
DAEN-ZCH-S	Housing Systems Branch	
DAEN-ZCH-F	Facilities Branch	
Pulaski total		135
Grand total		232

Table 2

General Problems and Possible Solution Through Office Automation

Problems	Solutions
Nonautomatic local communication	Local area network
Slow remote communication	TymNet engines/high-speed lines
Slow mass output	High-speed printers
Terminal input/output	Buffering/spooling
User contention for terminals	More terminals
Inconvenient location for terminals	More terminals located near users
Floppy disc management	Shared hard disks
Slow remote processing	Fast local processing (personal computer)
Manual graphics illustration	Machine color graphics; video, hardcopy, viewgraph
Lack of simple, general purpose software	Broad-based personal computer software
Unintegrated office procedures	Common hardware/software/communications
Limited technical skills, awareness	Training

5. Be capable of hardware/software integration to form a network using off-the-shelf technology

6. Interface with current USACE data bases and future engineer data bases as well as Army systems

7. Be relatively easy to relocate.

These guidelines for the OACE initiative can be summarized as follows: workstations must be linked together to take advantage of shared resources, e.g., printers, hard disks, and software, to provide local data sharing, and to allow remote communications with the OACE data bases.

Cost and Needs Analyses

These two classic considerations could be dismissed immediately. First, on a 3-year basis, a $2 million cost for hardware/software/communications purchase, lease, and maintenance does not weigh heavily against $36 million for labor and labor-related costs, and $18 billion for program management. In this context, OA can be considered office supplies. When other factors are considered, such as labor strength (space) limitations and responsiveness to the Army, DA, DOD, and Congress, the issue of cost in replacing machines for labor is overshadowed.

Second, the conventional workload analysis for existing and proposed systems in terms of input-processing-output, is unnecessary. One reason is that this analysis becomes input to the classic cost replacement analysis, which also is relatively unimportant. The other compelling reason is that the target offices are sophisticated in computer use. It is a waste of resources to perform such an analysis when key personnel in each office are knowledgeable in OA and have a clear grasp of their requirements.

3 SYSTEM DESIGN CONSIDERATIONS

The primary design considerations include overall system operational hardware, software, communications, maintenance, training, space, and cost objectives and constraints.

System Aspects

In some respects, OA acquisition decision-making is simpler for designing and procuring a large, complex system (as in this case) than for a single personal computer, word processor, or unintelligent terminal. The reason is that, with larger systems, the options are limited by inherent technological and organizational constraints.

Three service levels must be provided: (1) individual work station, (2) office, and (3) building. The building service level effectively provides a fourth level as well--worldwide communications and data sharing. The first column of Table 3 shows the variety of items considered for each level. Footnotes to this table show that not all items can occur in one system configuration. In summary, these items are:

Work Station	P, P1, P1C, P2, P2C--Personal computer (professional)
P2T, P2T*	Word processing (clerical)
U, U2	Unintelligent terminal (general)
M	Modem
SWP	Software package, personal
Office	PCP--Portable personal computer
U	Portable unintelligent terminal
PL	Plotter
CGP	Color graphics printer
SWO	Software package, office
Building	LP--Laser printer
OCR	Optical character reader
TNE	TymNet engine
LL	Leased line (high-speed)
LAN	Local area network
OAS	Office automation server

Design considerations were established for the three service levels, and the basic system can be analyzed by studying the equipment discussed in this chapter. In Chapter 6 three designs are selected, one for each of the three implementation phases. Using these designs, equipment will be selected by conventional Government procurement.

Table 3

Hardware, Software, and Communications--Existing and Requested

Item Location	Existing and Ordered: On Hand	On Order	Baseline Total	Retain On Hand	Requested: First Analysis: Test Plan: Procure	Test Plan: Total	Total Reqd	Second Analysis: Init Issue: Procure	Init Issue: Total	Total Reqd
Workstation	(54)	(26)	(80)	(19)	(65)	(77)	(129)	(85)	(100)	(139)
P	3	2	5				3	3	3	3
PT	4	1	5				5	5	5	5
P1	1		1		6	6	12	13	13	20
P1C					11	11	21	13	13	25
P2		2	2		4	4	5	2	2	2
P2C		12	12		8	8	17	17	17	20
P2T/P1T/W	7	5	12		22	22	25	19	19	25
P2T*/P1T*/W*	4		4		6	6	8	4	4	8
U	20		20	8		1	11		4	11
U1	13	4	17	11		11	11	1	12	12
U2	2		2		8	8	11	8	8	8
M[1]	48	26	74	3	-	-	-	85	100	132
SWP, PC[2]	2	6	8	1	36	36	70	52	52	74
SWP, WP	4	6	10	4	-	-	-	23	23	33
Office										
PCP[3]		5	5		7	7	7	7	7	7
U[3]	3	4	7	3	4	7	7	4	7	7
PLS	1	3	4	1	8	8	9	8	9	9
CGP		3	3		9	9	13	6	6	6
SWO		1	1		7	7	10	10	10	12
MUX4[1]					1	1	1			1
MUX8[1]					9	9	9			10
MUX12[1]					5	5	5			5
Building										
CP[4]								2	2	
LP[4]					2	2	2			2
PLM	2		2		2	2	2		2	2
OCR					1	1	2			2
TNE								2	2	4
LL 9600/DC					1	1	1	1	1	1
LL 9600/TX					2	2	2	2	2	3
LL 19200/TX										1
LAN[1]								2	2	2
OAS							2			

[1]Either modems or multiplexers or local area networks.
[2]Includes PCP basic software package.
[3]Includes modems.
[4]Either chain printers or laser printers.

Communications

TymNet Engine

There are two aspects to communication--remote and local. Physically, all communications converge at a gateway (or concentrator, or multiplexer). Because of heavy dependence on Tymshare remote data processing, a decision must be made to accept or reject the TymNet engine as a gateway. The TymNet engine is required on technical grounds for nonlocal communications. Cost and other factors suggest that the TymNet engine is a satisfactory solution. The next questions: what kind and how many TymNet engines?

Each building requires a 64-port TymNet Mini-Engine 3 for workstations and a 32-port TymNet Mini-Engine 1 to manage a laser printer. OACE transmission to the Mini-Engine 3 is 1200 bits per second (bps); output to Dallas, TX, or elsewhere is governed by the number of outgoing lines and their capacities. The Mini-Engine 3 is not required in system configurations that contain powerful office automation servers (OAS), such as the DEC PDP-11/750 VAX, or similar minicomputers.

Leased Lines

The number of leased lines will depend on traffic. Initially, it can be assumed that there is one leased 9600 baud line from each TymNet Engine to Dallas and one such line connecting the two Mini-Engine 3s within Washington, D.C.

Local Area Networks

Several modes can be used for local communication. With modems (modulators-demodulators), all data can be routed within PAX through the primary data center in Dallas. However, transmission rates are limited by the user's willingness to pay (higher prices for higher speeds) and the data center's ability to respond. Modems and line costs are expensive.

The TymNet engines themselves can provide some local, as well as remote, communication. However, the Mini-Engine 3 will accept, at most, 64 local lines at 1200 baud. Local communication is by a loop back through the engine; this connects a personal computer set up to transmit and one set up to receive.

Higher transmission rates and larger capacity suggest a local area network for local communication, with augmentation by small or large processors. Transmission rates range from 19.2 kilobits per second (Kbps), as with the Sytek broadband local area network, to 10 megabits per second (Mbps) for the 3 Com (Ethernet) baseband approach. Note that a 320-kilobyte floppy disc requires 3 min to transfer at 19.2 Kbps, but only 1/3 sec at 10 Mbps. (For a 10-megabyte hard disc, multiply these times by 30.)

Office Automation Server (OAS)

An OAS implies one or more processors and large disc storage. The DEC PDP 11/750 VAX with a disk drive would qualify. The DEC approach would require a DEC PDP-11/750 VAX in the Pentagon and DEC PDP-11/780 VAX augmentation

in the Pulaski Building. Other vendors such as Wang and Xerox have similar OASs.

One advantage of the OAS as an intermediary is that fewer TymNet engines are required because all workstations are connected to the intermediary; only the number of ports needed for active communication to remote data centers are connected to TymNet engines. By hard wiring workstations to multiplexers and an OAS, high transmission rates are possible. The ideal functional arrangement is the combination of a powerful OAS with a fast local area network and TymNet engines for remote communications.

Disadvantages of an OAS include: (1) high initial cost, (2) a failure takes the whole system down, (3) possible space management problems, and (4) an individual(s) must be responsible for the OAS.

Systems Assemblies

Nine systems configurations were evaluated. Characteristics differentiating these systems centered on communications. Thus, system selection depends on the willingness to pay for a given performance level. Table 4 shows the nine systems and their main features. System no. 1 is the existing one and represents a baseline.

Workstations and Support Hardware

Professional Workstations

Professional workstations are personal computers with access to dot matrix printers. The first type (P) listed below is the TRS-80 Model 12. The other four types have more than one manufacturer.

P Keyboard
CRT, monochrome (green), 24 lines, 80 characters per line
128 kilobytes random access main memory
2-1.25 megabyte floppy disc drives
Dot matrix printer, 80/132/220 columns

P1 Keyboard
CRT, monochrome, 24 lines, 80 or 80/132 characters per line
128 kilobytes random access main memory
2-320 kilobyte floppy disc drives
Dot matrix printer, 80/132 columns minimum (220 columns preferred)
(USI multidisplay card for IBM)

P1C P1 minus monochrome CRT and plus color CRT

P2 P1 plus:
128 kilobytes random access main memory (total: 256K RAM)
1-10 megabyte hard disc

P2C P2 minus monochrome CRT and plus color CRT.

Table 4

Nine System Configurations Evaluated

Sys No.	Modem	Multiplexer	TymNet Engines	Office Auto. Server	Local Area Network	Max. Local Mbps
1	X					.0012
2			4			.0012
3		X	2	X		.0096
4			4		PCnet	1.0
5			4		Corvus	1.0
6			4		Sytek	.0192
7			4		3Com	10.0
8			2	X	3Com	10.0
9			2	X	Sytek	.0192

Word Processing Workstations

Word processing (clerical) workstations are personal computers with daisy wheel printers and cut-sheet feeders. With no OAS, clerical workstations need a stand-alone personal computer capability. To eliminate floppy-disc management problems, the stand-alone clerical station without backup should be of the P2 class. With an OAS, a P1 class station is desirable to provide independent operation in case the server fails. The first type (PT) listed below is a TRS-80 Model 12. The last two types (W and W*) are centrally driven word processing stations. The others (P1T, P1T*, P2T, and P2T*) have more than one manufacturer. It was found that one-half the typist workstations could be paired to operate with one printer and one sheet feeder between them. Thus, asterisked types are defined as having no printer and sheet feeder, and represent one-fourth the total stations. (Not all potential system configurations support shared printers without operator intervention. An OAS is one way to provide this support.)

PT P minus the matrix printer and plus the Daisy Wheel II printer

P1T P1 minus the matrix printer,
plus a daisy wheel printer and sheet feeder, 132/158 columns,
10 or 12 pitch, 30-40 characters/sec

P1T* P1 minus the matrix printer

P2T P2 minus the matrix printer,
plus a daisy wheel printer and sheet feeder, up to 203 columns,
10 or 12 pitch, 30-40 characters/sec

P2T* P2T minus daisy wheel printer and cut-sheet feeder

W centrally driven work station, 92-character keyboard, daisy wheel printer, cut-sheet feeder

W* W less daisy wheel printer and cut-sheet feeder

It was mentioned that there are three major types of word processing stations, but seven were listed. This means any one system configuration can have only three types--the PT plus the W and W*, the P1T and P1T*, or the P2T and P2T*.

Unintelligent Terminals

Unintelligent terminals have been grouped into three types: several special purpose and miscellaneous items (U), and two types of general purpose terminals (U1 and U2).

U Keyboard/CRTs (three each) hardwired to a Worldwide Military Command and Control System (WWMMCS) processor, with auxiliary terminal printers, high-speed printer (600 lines/min), 1-megabyte main memory, 40-megabyte hard disc, and an 11 in. x 17 in. medium-sized plotter (Government-owned, used by DAEN-ZCI)

General Electric (GE) MarkLink System, consisting of four Texas Instrument (TI) 911 Video Terminals linked to a TI 990 processor with a 10-megabyte hard disk and GE 200 line printer (leased, used by DAEN-ZCF)

Teletype 43 keyboard/printers (three each) (Government-owned, retained within DAEN-ZCF)

OMRON 8025G24 Keyboard/CRT (Government-owned, retained within DAEN-ZCP-M)

U1 Keyboard, dot matrix printer, up to 220 columns, 150 characters/sec
Up to 9600 baud, 1280-character line buffer
Auto-answer/disconnect, 21 characters programmable answerback
Current loop interface, multiple default configuration

U2 U1 plus monochrome CRT (green), 24 lines, 80 characters/line

Support Hardware

Some less frequently used items were already distributed, several to each building. These include:

M Modem, 300- to 1200-baud with auto-dial/auto-answer for personal computers (used as backup in case of TymNet engine auto-answer failure)

PCP Portable personal computer:
Keyboard, CRT, monochrome, 25 lines, 80 characters/line
128 kilobyte random access memory (expandable to 512K)
two 320-kilobyte disc drives

U TI Silent 700, keyboard/printer, Models 745 and 787

PL Plotter, with overhead viewgraph kit

CGP Printer, color graphics, prism
80/132 columns
Dot-plot graphics
Graphics software
Semiautomatic cut-sheet feeder

MUX Multiplexer, 9600 baud; 4, 8, and 12 port (required for only one system configuration considered).

Some items serving all users in a building were discussed in the preceding section on communications. These are the TymNet engine (TNE), leased lines (LL), local area network (LAN), and office automation server (OAS). Until recently, it was estimated that some time would elapse before the TNE would work well with laser printers, requiring temporary installation of chain printers (CP). However, it now appears that the laser printers will be installed initially. Other items are:

LP Laser printer
12 pages/min (approximately 600 lines/min)
132 columns
Dual sheet feeder, 500-sheet capacity
Small size, 36 in. x 25.8 in. x 26 in.
Output stacker

OCR Optical character reader
12 pages/min
Underlining
10/12 pitch
50-sheet stack feeder
Key optics editing.

Workstations and Support Software

Professional Workstations

A core of basic routines is required for each workstation to give users a broad-based capability and encourage them to use the routines often enough that operating commands are committed to memory. Ideally, the routines should be fully integrated so that information can flow from one routine to another with a minimum of keystrokes and user confusion. At the time of this study, the only available package of integrated routines was the Apple Lisa, for which overall costs precluded its selection. However, software industry announcements indicate that integrated packages will be available soon for the IBM personal computer.

An industry consensus is that personal computer users require word processing, spreadsheet, data-base management, and graphics capabilities as a minimum. Time management routines may be added. If so, these routines require operating system routines in the background. Software selection may seem complicated by the variety of choices, but is not too difficult given the organizational and hardware constraints.

Operating Systems. Popular routines are available for personal computers that have a wide range of manufacturers. Most operate in a CP/M-80/86 or MS/DOS (or IBM/DOS) environment, suggesting it may be worthwhile to procure two systems. Also, when an operating system changes, it will be necessary to have both the older and newer versions available, since software routines have not been upwardly compatible. New software often requires conversions from the manufacturers, which may not be available for many months, if ever.

Word Processing. Word processing on personal computers must be compatible with word processing workstations if information is to flow smoothly back and forth. (Note: professional employees originate text.) A price must be paid for power, the more powerful routines, such as Wordstar, having a high initial threshold of difficulty, though yielding greater long-term efficiencies for intensive users (typists). Many professionals use Wordstar successfully, but because of its relative difficulty, it is not suitable for the OACE professional environment. Select is an excellent, easily learned routine; a 90-minute instruction is usually enough. Select may be a satisfactory solution for OACE clerical personnel as well. OACE's relatively simple technical typing requirements (among other factors) would permit use of a simpler routine. Select is available for major personal computer brands (TRS-80 personal computers, however, are wedded to SCRIPSIT.) Also, Select is compatible with the more powerful DEC ALL-IN-1 software used on VAX processors. Thus, professionals can use Select while typists are using ALL-IN-1 in a DEC environment, and the two can exchange files.

Spreadsheet. USA-CERL investigations support the view that the widely popular Supercalc 3 is an excellent choice. However, Lotus 1, 2, 3, and VisiCalc are also good choices.

Data-Base Management. Something more than simple file management is required. At the study outset, the consensus was that dBASE II would be a good choice for professionals. However, during the study, Information Builders, Inc. (IBI) released a personal computer version of FOCUS, called PC FOCUS, which should also be considered. Each copy of PC FOCUS can cost two to three times as much as dBASE II and, as yet, IBI has not granted a license to reproduce this program. Although PC FOCUS operational capabilities have not been verified, it must be realized that OACE has a heavy involvement in FOCUS, the data-base management system that supports its major Tymshare-resident routines. OACE has a commitment in previous and planned FOCUS training for its employees, so that investment in both dBASE II and FOCUS could cause unnecessary turmoil. The choice of data-base management system has not been decided, but current inclinations favor PC FOCUS.

Business Graphics. Lotus 1, 2, 3, and Graphtalk (for DEC equipment) are good choices. Vision (operated like an Apple Lisa system) will soon be available and should prove to be a fine integrated package.

Time Management. Time management packages usually include several routines for, e.g., personal scheduling and appointments. Time Manager is adequate for IBM equipment and Datebook-86 is good enough for DEC equipment.

Less Frequently Used Routines. For an entire office, it is worthwhile to make available a network analysis routine (such as Milestone 86), a statistics routine (such as Microstat), and an MBASIC interpreter. OACE professionals occasionally run BASIC routines that require an interpreter, rather than programming BASIC routines that require a compiler.

Communications. Most personal computers require emulation packages for bisynchronous and asynchronous communications. Examples are VT100 emulation for transmitting American Standard Code for Information Interchange (ASCII) files and asynchronous communication, and the 3270 for bisynchronous communications.

Word Processing Workstations

The primary restriction is that word processing workstation software be compatible with that of professional workstations. The clerical workstation software package would normally require an operating system, word processing, spreadsheet, time management (perhaps), and VT100 emulation for IBM.

Maintenance

Direct maintenance dollar cost is expensive. For example, Tables 9 and 11 (Chapter 5) show that annual station maintenance cost can be 16 to 21 percent of the purchase cost (IBM vendor: 95,166/586,255 = 16.2 percent; DEC vendor: 151,851/714,115 = 21.2 percent). The 3-year maintenance/purchase percentages can range from 49 to 64 percent. (Table 13 is not a good indicator of total maintenance costs because TymNet engine and leased line maintenance are included in acquisition cost totals.) Indirect maintenance costs can arise as a result of poor maintenance and a poor maintenance program, loss of organizational production due to downtime, and maintenance management complexities. Initial maintenance decisions greatly affect equipment selection and, in turn, overall system (and mission) performance and maintenance costs. The following considerations apply.

1. Maintenance, regardless of who maintains, is simplified by procuring as few types of equipment as possible. This consideration certainly influenced the decision to have only five major types of professional workstation, to make the word processing workstations differ from professional ones only by substituting daisy wheel printers and cut-sheet feeders for dot matrix printers, and to have two basic unintelligent terminal types (U1 and U2).

2. Hardware (and software) should have a proven record of reliability.

3. If the hardware vendor can (or will) not maintain equipment locally, competent local maintainers are a must. Under these circumstances, lower costs will result if there is local competition among quality contractors.

4. The hardware vendor should be financially sound and the equipment selected should be profitable (so that production can feasibly continue).

Ideally, a long future production run should be scheduled; otherwise, obsolete equipment will be bought for which there will be neither spare parts nor maintenance expertise.

5. Heavily used equipment, unintelligent terminals, and word processors must take a lot of hard use. For example, some personal computer keyboards are designed improperly for typing, and will not take an 8-hr/day pounding day after day.

6. Hard disks are more productive than floppy disks and are less susceptible to contamination.

7. Equipment should generate as little heat as possible to avoid special cooling needs.

8. Equipment should be electrically isolated so as not to damage or be damaged.

Space

Space is a special consideration in the Pentagon and the Pulaski Building. Figures 1 and 2 give a layout of the offices involved, which offer approximately 26,000 sq ft (2392 m^2) for 232 people, or 113 sq ft (10.4 m^2) per person (including equipment and interior paths). Appendix A discusses space problems and solutions.

Compact workstation equipment was favored, so building equipment considerations included compactness and avoidance of special cooling requirements. For example, a solution involving placement of a mainframe in the building was not physically desirable, as mainframes have narrow temperature operating ranges and may require special cooling. Similarly, a TymNet engine larger than the Mini-Engine 3 was rejected, partly because of cooling needs.

To avoid the space and cost technical difficulties as well as procedural problems associated with installing an additional telephone for each workstation, the workstation configuration was designed based on modem communication. Thus, intelligent workstations would have modems with an auto-dial feature.

Cost

From a system design viewpoint, it is necessary only to have very good, representative cost data of consistent quality. Once all operationally feasible systems have been considered and the choices have been narrowed by a cost/performance analysis, a more intensive look at individual component items is needed. A cost-based system analysis also has bearing on phased implementation. Systems analysis can point out system configurations that require a heavy initial investment and reduce the downstream options at decision points between and within implementation phases. Also, the analysis can show that systems just barely meeting functional requirements may have low initial cost, but do not look as good from a cost/performance viewpoint. (As noted at the

SCALE: 1" = 40"

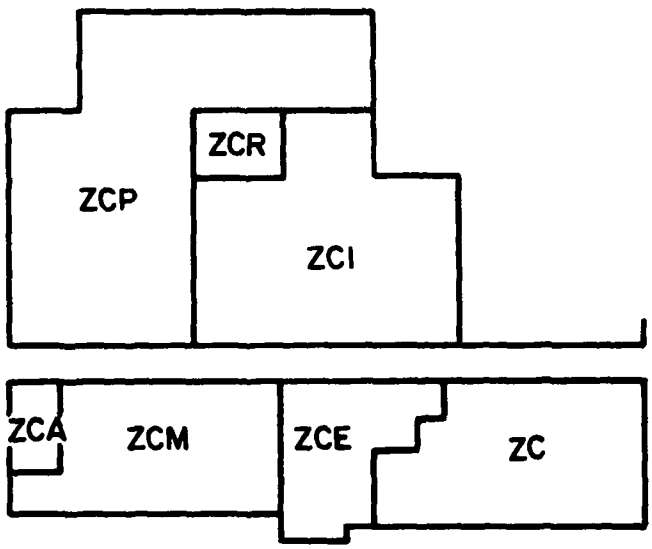

Figure 1. OACE office locations (the Pentagon).

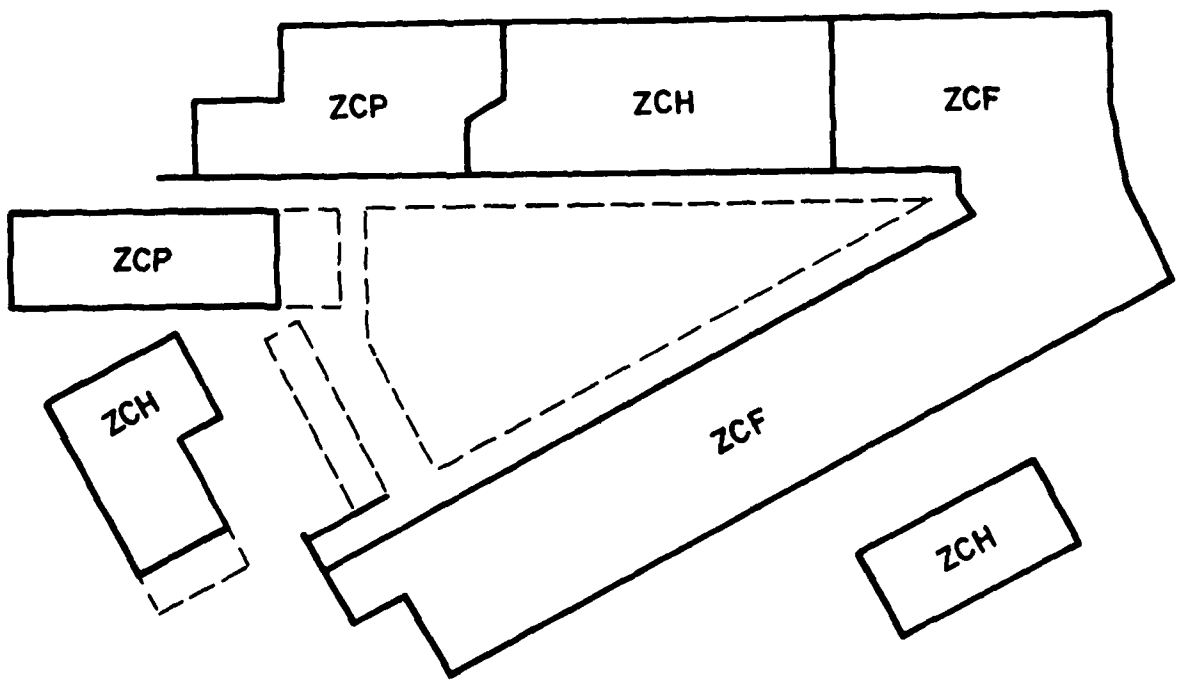

Figure 2. OACE office locations (Pulaski Building).

beginning of this chapter, equipment is discussed here in terms of design. Final selection will be by Government procurement.)

As discussed in Chapter 2, cost replacement of machine for labor is irrelevant; only equipment-related costs need to be considered. Chapter 5 discusses cost in more detail.

4 HARDWARE, SOFTWARE, AND COMMUNICATIONS REQUIREMENTS

Data Collection: Identifying Requirements

OACE's hardware, software, and communications requirements with the OA were studied considering the equipment already in place (Appendix B). Figure 3 shows the workstation requirements symbols used on the requirements data form (Figure 4). Figure 4 evolved from more complicated forms designed to record requirements comprehensively. After experiments with personal interviews and attempts to reduce the data, Figure 4 emerged as a form containing all essential information that could be transformed and summarized easily.

The symbols sheet and data form proved to be readily understandable by key OACE employees who were familiar with OA. After about 1 hr discussion, partly to insure that the symbols were understood and partly to review OACE operational objectives and individual office objectives, those employees were able to fill in the form quickly and accurately. Follow-up interviews disclosed that few points required clarification. The interviewer completed some of the forms using information previously recorded on experimental data sheets. Appendix A contains the results.

Although the data form is workstation-oriented, it is designed to elicit user information on office and building support. A preference for color was intentionally omitted from the form, along with some other items that everyone agreed would be nice features, but might not be practical for cost, space, and other reasons. Thus, some judgment was required to transform source data into a description of actual equipment for an integrated system. For example, it was decided that those who expressed a need for a graphics printer would have access to a color graphics printer on an office basis and those who requested graphics software would have color CRTs. A check mark for modem means that an individual needs remote communication capability, requiring a modem either at the workstation or elsewhere in the building (such as at a TymNet engine) to access a leased line.

As an aid to visualizing users and equipment in space, 28 in. x 40 in. (70 cm x 1 m) architectural drawings were prepared at a scale of 96:1 (1/8 in. = 1 ft; .313 cm = 30 cm) one drawing for the Pentagon and one for the Pulaski Building. These drawings were extremely useful, but cumbersome. Similar drawings later were prepared on a personal computer (Appendix C). These plans are large-scale, convenient, readily modified, and each was produced in approximately 20 min.

Existing and Ordered Data Items

Appendix B supports the "On Hand" and "Retain On Hand" columns of Table 3. Fifty-four workstations were already in place and, with the 26 on order, provide a baseline for irreducible requirements. The ordered (as well as existing) equipment is justified in light of the obvious user contention for terminals documented in Appendix B. The worst case was in DAEN-ZCP-P (Pentagon), with 11 users contending for one terminal (along with other nearby terminals). This situation is unnecessary because the equipment needed to support these employees is relatively inexpensive.

```
FUNCTION
 P = Professional computer (intelligent, programmable terminal with main
       [primary] memory, and usually, secondary [disc, floppy or hard] memory)
 U = Unintelligent terminal
 W = Word Processor terminal
 G = Graphics terminal
LOCATION
 Office Branch and section symbols
 Room  Last three digits (e.g., 219 for Pulaski Bldg, Room 2219)
 Area  First and last initials of nearest employee, or
         Vac for vacant position or
       Con for contractor employee, or
       Comp for computer room, or
       Ent for entrance
COMPONENTS
 Printer
       Quality
           R = Readable
           G = Good
           C = Correspondence
           L = Letter
       Element
           T = Thermal
           M = Matrix
           D = Daisy wheel
           B = Ball
           C = Chain or Belt Driven
SUPPORT HARDWARE
   Plotter (size)
       S = Small   8-1/2" x 11"
       M = Medium     11" x 17"
       L = Large      28" x 40"
SUPPORT SOFTWARE
   Operating System
       DOS  = Disc Operating System
       TRS  = Tandy Radio Shack DOS
       CP/M = Control Program for Microprocessors
   DBMS  (none, one, or more than one of the below)
       F = FOCUS
       X = General purpose
   Compilers  (none, one, ro more than one of the below)
       B = Basic
       F = FORTRAN
       C = COBOL
       P = Pascal
       p = UCSD p-System
USERS
   First and last initials of employee, or
   Vac for vacant position, or
   Con for contractor employee, or
   Other for other, or
   Gen Use for general use (add Port for portable)
```

Figure 3. Workstation requirements symbols.

WORK STATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FUNCTION															
LOCATION															
Office															
Room															
Area															
COMPONENTS															
Keyboard															
CRT (chars)															
Printer (chars)															
Quality															
Element															
Modem															
Processor															
Main Memory (KB)															
Disc (MB)															
SUPPORT HARDWARE															
Interoffice Comm															
Processor															
Main Memory															
Hard Disc															
Modem															
Fast Printer															
Sheet Feeder															
Plotter (size)															
Graphics Printer															
Viewgraphs															
2"x2" Slides															
Microfiche															
OCR															
SUPPORT SOFTWARE															
Operating System															
Word Processing															
Spread Sheet															
DBMS															
Statistics															
Network Analysis															
Graphics															
Time Management															
Compilers															
USERS															

Figure 4. Workstation requirements data form.

Comparing the "Existing and Ordered" section of Table 3 with the "Requested" section, shows that existing and ordered equipment have little office and building support. No communication was occurring between word processors because of technical complexities. Existing equipment centered on word processing and unintelligent terminal access to remote data centers.

Requested Items--First Analysis

After reviewing the requirements, USA-CERL prepared a test plan (not included in this report) as a first phase, overall system implementation. This plan contained 77 of the 129 requested workstations and almost all office and building support equipment. Of the 77 total stations in the test plan (Table 3), only 65 required procurement (see "Procurement" column of Table 3). Twelve on-hand unintelligent terminals could be used in the test use (77 - 12 = 65). DAEN-ZCF's TRS-80 personal computers for professional use and word processing, the Teletype 43 unintelligent terminals, and the GE MarkLink system were excluded from the test plan for lack of commonality.

Requested Items--Second Analysis

The second analysis resulted from incorporating review comments from the Technical Monitor and key employees into the first plan (Table 3). The "Total Required" column (139) in Table 3 is the same as the far right column of Table 5. Table 5 breaks down the requested equipment by building and by office within building and summarizes this information in the last column. "Workstation" entries in Table 5 summarize the equipment requirements from the next-to-last column in Appendix D. Appendix D workstations are associated with the nearest individuals rather than assigning one person per station.

The "procurement" column (85) for initial issue in Table 3 represents the difference between the 100 total initial issue request and the 15 existing unintelligent terminals to be retained. This column in Table 3 is the same as the far right column of Table 6. Table 6 breaks down the requested equipment by building and by office within building, and summarizes this information in the last column.

Strength and Requested Workstations Analysis

Table 7 summarizes personnel strength by office, building, grade, and function. The bottom of the table shows the total required workstations and number of personnel per workstation at each office building. Two large offices, DAEN-ZCF and DAEN-ZCH, have low workstation density.

Table 5

Hardware, Software, and Communications Requirements Summary

Item	Pentagon								Pulaski				OACE
Location	ZCZ	ZCE	ZCM	ZCA	ZCI	ZCR	ZCP	Total	ZCP	ZCF	ZCH	Total	Total
Workstation	(8)	(9)	(15)	(3)	(13)	(3)	(21)	(72)	(23)	(18)	(26)	(67)	(139)
P										3		3	3
PT										5		5	5
P1		5		1	4		6	16	3	1		4	20
P1C	3	2	11			2	2	20	5			5	25
P2	1				1			2					2
P2C	1							1			19	19	20
P2T/P1T/W	2	1	2	1	3	1	5	15	3	2	5	10	25
P2T*/P1T*/W*	1	1	1	1	2		1	7			1	1	8
U					3			3	1	7		8	11
U1							3	3	8		1	9	12
U2			1				4	5	3			3	8
M[1]	8	9	15	3	10	3	21	69	23	14	6	63	132
SWP, PC[2]	6	8	12	1	5	2	9	43	9	1	21	31	74
SWP, WP	3	2	3	2	5	1	6	22	3	2	6	11	33
Office													
PCP[3]	1	1	1				1	4	1		2	3	7
U[3]						2	2	4	3			3	7
PLS		1	1		1	1	1	5	1	1	2	4	9
CGP			2					2	1		3	4	6
SWO		1	2		1	1	1	6	2	1	3	6	12
MUX4[1]				1				1					1
MUX8[1]			2			1	1	4	2		4	6	10
MUX12[1]	1	1			1		1	4	1			1	5
Building													
LP[4]								1				1	2
PLM								1				1	2
OCR								1				1	2
TE								2				2	4
LL 9600/DC								1					1
LL 9600/TX								1				2	3
LL 19200/TX								1					1
LAN[1]								1				1	2
OAS								1				1	2

[1]Either modems or multiplexers or local area networks.
[2]Include PCP basic software package.
[3]Includes modems.
[4]Either chain printers or laser printers.

Table 6

Hardware, Software, and Communications--Requested Initial Issue (Procurement)

Item	Pentagon								Pulaski				OACE
Location	ZCZ	ZCE	ZCM	ZCA	ZCI	ZCR	ZCP	Total	ZCP	ZCF	ZCH	Total	Total
Workstation	(3)	(6)	(10)	(2)	(7)	(3)	(15)	(46)	(9)	(9)	(21)	(39)	(85)
P										3		3	3
PT										5		5	5
P1		3		1	1		6	11	1	1		2	13
P1C		1	6			2	2	11	2			2	13
P2	1				1			2					2
P2C	1							1			16	16	17
P2T	1	1	2	1	3	1	3	12	2		5	7	19
P2T*		1	1		2			4					4
U					0[1]				0[4]	0[7]			
U1							0[3]		1[5]		0[9]	1	1
U2			1				4	5	3			3	8
M													
SWP, PC	3	5	7	1	2	2	9	29	4	1	18	23	52
SWP, WP	1	2	3	1	5	1	3	16	2		5	7	23
Office													
PCP	1	1	1				1	4	1		2	3	7
U						0[2]	0[2]	0	0[6]			0	0
PLS		1	1		1	1	1	5	1	0[8]	2	3	8
CGP			2					2	1		3	4	6
SWO		1	1		1	1	1	5	1	1	3	5	10
UX4													
MUX8													
MUX12													
Building													
CP								1				1	2
LP													
PLM								1				1	2
OCR													
TNE								1				1	2
LL 600/DC								1					1
LL 9600/TX								1				1	2
LL 19200/TX													
LAN (Wired)								1				1	2
OAS													

Existing Equipment:

[1]Two WWMCCS terminals to be upgraded later with 1 more terminal required.
[2]Two TI Silent 700 Model 787, leased.
[3]Three TI OMNI 800 Model 820 KSR, Government half-owned.
[4]One OMRON 8025G24 Government owned.
[5]Seven TI OMNI 800 Model 820 KSR, Government half-owned.
[6]Three TI Silent 700 Model 745, Government owned.
[7]Four TI 911, leased; and 3 Teletype 43, Government owned.
[8]One 8-1/2 x 11 plotter, leased.
[9]One TI OMNI 800 Model 820 KSR, Government half-owned.

Table 7

OACE Authorized Strength and Grades--
Required Workstations and Personnel per Workstation

Function	Mil Rank	Civ Grade	Pentagon ZCZ	ZCE	ZCM	ZCA	ZCI	ZCR	ZCP	Total	Pulaski ZCP	ZCF	ZCH	Tot	OACE Total	Function Total
Executive	08		1							1					1	
	07	ES	2							2		1		1	3	4
Managerial	06	15	1	1	1		3	1	3	10	1	5	6	12	22	22
Professional	05	14	1	3	7		8	2	6	27	2	19	12	33	60	
	04	13		3	4		4	1	5	17	5	12	8	25	42	
	03/E9	12		1	2		4	1		8	6	8	10	24	32	
		11					1		1	2	3	3	1	7	9	
	E7	10	1							1					1	
		9	1			1			1	3		1	3	4	7	151
Clerical, Support		8	2							2					2	
		7			1	1	2		3	7	1	2	2	5	12	
		6		1	1		2	1	3	8	2	4	5	11	19	
		5		1	1	1	3			6		3	1	4	10	
		4							1	1	1	1	1	3	4	
		3 2			1				1	2			1	1	3	50
Contractor											4	1		5	5	5
Total personnal			9	10	18	3	26	6	24	97	25	60	50	135	232	232
Total required workstations			8	9	15	3	13	3	21	72	23	18	26	67	139	
Persons/workstation			1.1	1.1	1.2	1.0	2.1	2.0	1.1	1.3	1.1	3.4	1.9	2.0	1.7	

5 COSTS

Cost Data Collection Procedures

Representative costs were prepared from a cost/benefit analysis for workstations and feasible OA systems in the OACE environment. Cost data were obtained directly from vendors serving the Washington, D.C., area. As vendors, manufacturers have a General Services Administration (GSA) contractual agreement with the Government. The contract is called "FSC Group 1, Part 1, Section A - General Purpose ADP Equipment and Software." (FSC is Federal Supply Catalogue.) The terms of the agreement are important and must reflect the built-in Government discount, which should be approximately 15 percent of the list price.

Generally, prices suggested in this chapter are based on current GSA information. Since these prices are from one source, they are consistent for decision-making. Actual procurement costs may be lower, since there are often several locally competing vendors for a given manufacturer's equipment. In addition, the GSA Computer Store at the GSA Building in a competitor.

Costing some equipment is simple. For example, although the particular type of optical character reader being considered is marketed under different labels, there are actually very few manufacturers; thus, the price range is narrow. In other cases, such as for Tymshare, Inc.'s TymNet engines and AT&T's leased lines, there is no option on source and thus, little margin for bargaining.

Although many vendors offer workstations, the costing task is not as formidable as it might first appear. First, only workstations that can function well in the overall system environment may be considered, regardless of how well those stations may perform in a stand-alone mode. Also, OACE requirements are in the middle range of equipment capability--neither simple nor highly sophisticated. The choices can be narrowed further by using a rating procedure of the type shown in Table 8.

Table 8 gives a cost per quality point (cost/benefit) ratio on the bottom line. The next-to-last line (total work stations cost) and second-from-last line (total quality points, a maximum of 100) can be based on an individual workstation or a group of work stations (e.g., the total cost for 139 workstations in Table 9).

System Configuration Based on Independent Hardware Purchase Costs

Table 9 shows the system configuration based on independent hardware purchase costs for workstations, office equipment, and building equipment. Communications generally are excluded. Lease costs, as contrasted with purchase costs, are not really an issue. Although some items may be leased for a few months, leasing cannot be tolerated for a greater period because, after approximately 11 months, the price equals the purchase cost.

Approximately 80 percent of the Table 9 costs are concentrated in workstations, the remaining 20 percent being office and building equipment. Two

Table 8

Workstations Features Comparison

Feature / Subfeature	Points	Vendor 1	2	3	4	5	6	7
Integration compatability	(20 max.)							
Ease of workstation use	0-3	—	—	—	—	—	—	—
Fast spooled printing support	0 or 2	—	—	—	—	—	—	—
Different location printing support	0 or 3	—	—	—	—	—	—	—
User interface consistency	0-4	—	—	—	—	—	—	—
Local support for large jobs	0 or 4	—	—	—	—	—	—	—
Existing equipment integration	0-2	—	—	—	—	—	—	—
Integrated office system	0-2	—	—	—	—	—	—	—
Remote access	(20 max.)							
PC FOCUS available or planned	0 or 5	—	—	—	—	—	—	—
PC FOCUS offline edit and upload	0 or 4	—	—	—	—	—	—	—
Lines to Tymshare (no. lines x 2)	0 or 4	—	—	—	—	—	—	—
Direct connection to TymNet engine	0 or 2	—	—	—	—	—	—	—
Batch access	0 or 1	—	—	—	—	—	—	—
Access to other than Tymshare	0 or 2	—	—	—	—	—	—	—
File transfer	0 or 2	—	—	—	—	—	—	—
Upgradability	(16 max.)							
Expansion board slots: 0-5, >5	1 or 2	—	—	—	—	—	—	—
RAM potential: 256K, 512K, >512K	1-3	—	—	—	—	—	—	—
Hard disc potential: 5, 10, and >10 Mb	1-3	—	—	—	—	—	—	—
Processor upgrade potential	0-4	—	—	—	—	—	—	—
MS/DOS and CP/M	0 or 3	—	—	—	—	—	—	—
Mainframe/minicomputer interface	0 or 1	—	—	—	—	—	—	—
Third party support	(16 max.)							
Present hardware	0-4	—	—	—	—	—	—	—
Present software	0-4	—	—	—	—	—	—	—
Future hardware	0-4	—	—	—	—	—	—	—
Future software	0-4	—	—	—	—	—	—	—
Stand-alone capability	(10 max.)							
Hardware--subjective assessment	0-3	—	—	—	—	—	—	—
Software--subjective assessment	0-3	—	—	—	—	—	—	—
Shared file access	0 or 2	—	—	—	—	—	—	—
Shared dictionary, formats, etc.	0 or 2	—	—	—	—	—	—	—
Local communication	(8 max.)							
0, None; 2, slow coax; 4, fast coax	0,2,4	—	—	—	—	—	—	—
Standard ethernet	0 or 2	—	—	—	—	—	—	—
Asynchronous PC to PC communication	0 or 2	—	—	—	—	—	—	—
Specialty hardware	(5 max.)							
132 Column CRT display	0 or 3	—	—	—	—	—	—	—
Laser printer, controller, etc.	0 or 2	—	—	—	—	—	—	—
Performance	(5 max.)							
Subjective assessment	0-5	=	=	=	=	=	=	=
Total quality points		—	—	—	—	—	—	—
Total workstations cost (x $1000)		—	—	—	—	—	—	—
Total workstations cost/quality point								

Table 9

System Configuration Independent Hardware--Purchase Cost Comparison

Location	Item	Quantity	Vendor	Unit Cost	Total Cost	Vendor	Unit Cost	Total Cost
Work-station	P	3	TRS	4449	13,347	TRS	4449	13,347
	PT	5	TRS	5129	25,645	TRS	5129	25,645
	P1	20	IBM	3191	63,820	DEC	3478	69,560
	P1C	25	IBM	3425	85,625	DEC	4862	121,550
	P2	2	IBM	5324	10,648	DEC	6178	12,356
	P2C	20	IBM	5558	111,160	DEC	7562	151,240
	P2T	25	IBM	7847	196,175	DEC	9438	235,950
	P2T*	8	IBM	5067	40,536	DEC	5528	44,224
	U	11	Varies	Varies	-[1]	Varies	Varies	-[1]
	U1	12	TI	2345	15,243[2]	TI	2345	15,243[2]
	U2	8	TI	3007	24,056	DEC	3125	25,000
	Total	139			586,255			714,115[3]
Office	PCP	7	COMPAQ	4100	28,700			
	U	7	TI	-	9,604[4]			
	PLS	9	HP	1690	15,210			
	CGP	6	ID	2045	12,270			
	Total				65,784			
Building	LP	2	DEC	19,995	39,990			
	PLM	2	Houston Instr.	2,480	4,960			
	OCR	2	Compuscan	25,300	50,600			
	Total				95,550			

[1]Excluded: three terminal WWMCCS systems, $48,000; one Government-owned OMRON; four terminal MarkLink systems, $2040/mo; three Government-owned Teletype 43s.
[2]Full cost of one terminal plus half cost of 11 Government-half-owned terminals.
[3]When the DEC P1T and P1T* are substituted for the DEC P2T and P2T*, with respective unit costs of $6738 and $2828, the total workstation cost is $625,015.
[4]Included: four TI 787, $2401 each; excluded: three Government-owned TI 745s.

primary workstation manufacturers, IBM and DEC, are costed because they are competitive and provide a basis for comparison to other types.

Total System Acquisition Costs

Table 10 shows system acquisition costs for the nine system types considered. Since four system types can use either an IBM or DEC workstation, 13 system configurations are costed. The numbers in the first two purchase price columns are from Table 9. Since the TymNet engines and leased lines cannot be purchased outright, it was necessary to mix one-time purchase and annual lease costs. Therefore, 1- and 3-year total costs are shown for comparison. The total purchase price plus 1-year TymNet engine and leased line costs comprise the 1-year total cost. Similarly, the total purchase price plus the 3-year TymNet engine and leased line costs make up the 3-year total cost.

Systems 1 through 9 in Table 10 are listed in order of generally (though not precisely) increasing cost and performance. System 4, for example, has performance comparable to systems 7, 8, and 9, but system 3 does not have LAN-based local communication as do systems 4 through 9. Also, when the systems were being assigned, the costs and performance were unknown, so position was determined in part by similarity of communications.

System Configuration Based on Independent Maintenance Costs

Table 11 is set up like Table 9. Comparing the two tables reveals that maintenance costs can be substantial, as already noted in Chapter 3.

Total System Maintenance Costs

Table 12 is set up like Table 10. However, TymNet engine and leased line maintenance costs are included in the Table 10 annual lease costs and are not separable for inclusion in Table 12.

One- to Three-Year Acquisition and Maintenance Costs

Table 13 summarizes Tables 10 and 12. The 1- and 3-year costs of Tables 10 (acquisition) and 12 (maintenance) have been entered into Table 13 to yield total 1- and 3-year acquisition and maintenance costs.

System Features Comparison

Table 14 is similar to Table 8, but is on a system, rather than workstation, basis. Differences are: (1) the remote access feature has become two features in Table 14--remote access and specialty software; (2) upgradability and stand-alone capability do not appear in Table 14; and (3) two features have been added--vendor support and word processing.

Table 10

System Acquisition Cost Comparison (x $1000)

System No.	PC Vendor	LAN Vendor	Purchase Price (x $1000) Work Sta.[1]	Office & Building	Cost M	Cost MUX	LAN	OAS	Total[2]	Annual Lease, TNE+LL[3]	1-Yr Total Cost	3-Yr Total Cost
1	IBM		586	161	70				817		817	817
	DEC		714	161	70				945		945	945
2	IBM		586	161					747	220	967	1407
	DEC		714	161					875	220	1095	1535
3	DEC		625[4]	161		95		206	1087	177	1264	1618
4	IBM	PCnet	586	161			101		848	220	1068	1508
5	IBM	Corvus	586	161			79		826	220	1046	1486
	DEC	Corvus	714	161			79		954	220	1174	1614
6	IBM	Sytek	586	161			123		870	220	1090	1530
	DEC	Sytek	714	161			123		998	220	1218	1658
7	IBM	3Com	586	161			165		912	220	1132	1572
8	DEC	3Com	625[4]	161			165[5]	206	1157	177	1334	1688
9	DEC	Sytek	625[4]	161			123	206	1115	177	1292	1646

[1] If LAN were operational initially, printer and disc requirements would be lower.
[2] Totals do not include workstation software, office software, or all wire and installation fees.
[3] Systems 2, 4, 5, 6, and 7 are four TNE configurations. Systems 3, 8, and 9 are two TNE configurations. Lease costs include maintenance.
[4] P1T and P1T* substituted for P2T and P2T*.
[5] 3Com LAN is not available for DEC at this time, but is projected for the first quarter of C.84.

Table 11

System Configuration Independent Hardware--
Annual Maintenance Cost Comparison

Location	Item	Quantity	Vendor	Unit Cost	Total Cost	Vendor	Unit Cost	Total Cost
Work-station	P	3	TRS	591	1,773	TRS	591	1,773
	PT	5	TRS	678	3,390	TRS	678	3,390
	P1	20	IBM	438	8,760	DEC	624	12,480
	P1C	25	IBM	518	12,950	DEC	744	18,600
	P2	2	IBM	760	1,520	DEC	1,704	3,408
	P2C	20	IBM	840	16,800	DEC	1,824	36,480
	P2T	25	IBM	1,381	34,525	DEC	2,184	54,600
	P2T*	8	IBM	697	5,576	DEC	1,524	12,192
	U	11	Varies	Varies	-[1]	Varies	Varies	-[1]
	U1	12	TI	456	5,472	TI	456	5,472
	U2	8	TI	550	4,400	DEC	432	3,456
	Total	139			95,166			151,851[2]
Office	P1P	7	COMPAQ	646	4,522			
	U	7	TI	Varies[3]	1,866			
	PLS	9	HP	168	1,512			
	CGP	6	IDS	352	2,112			
	Total				10,012			
Building	LP	2	DEC	3,840	7,680			
	PLM	2	Houston Instr.	300	600			
	OCR	2	Compuscan	2,856	5,712			
	Total				13,992			

[1]Excluded: three terminal WWMCCS systems, $9972; one Government-owned OMRON; four terminal MarkLink systems (maintenance included with lease); three Government-owned Teletype 43s.

[2]When the DEC P1T and P1T* are substituted for the DEC P2T and P2T*, with respective unit costs of $1104 and $444, the total workstation cost is $117,155.

[3]Included: four TI 787s, $324 each; three TI 745s at approximately $190 each.

Table 12

System Annual Maintenance Cost Comparison (x $1000)

System No.	PC Vendor	LAN Vendor	Work Station	Office & Bldg.	M	MUX	LAN	OAS	Total	1-Yr Total Cost	3-Yr Total Cost
1	IBM		95	24	16				135	135	405
	DEC		152	24	16				192	192	576
2	IBM		95	24						119	357
	DEC		152	24						176	528
3	DEC		117[2]	24		8		17	166	166	498
4	IBM	PCnet	95	24			0		119	119	357
5	IBM	Corvus	95	24			5		124	124	372
	DEC	Corvus	152	24			5		181	181	543
6	IBM	Sytek	95	24			21		140	140	420
	DEC	Sytek	152	24			21		197	197	591
7	IBM	3Com	95	24			11		130	130	390
8	DEC	3Com	117[2]	24			11[3]	17	169	169	507
9	DEC	Sytek	117[2]	24			21	17	179	179	537

[1] If LAN were operational initially, printer and disk requirements would be lower.
[2] P1T and P1T* substituted for P2T and P2T*.
[3] 3Com LAN is not available for DEC at this time, but is projected for the first quarter of CY84.

Table 13

System Acquisition and Annual Maintenance Cost Comparison (x $1000)

System No.	Communications	PC Vendor	1-Yr Cost Acquire	1-Yr Cost Main-tain	1-Yr Cost Total	3-Yr Cost Acquire	3-Yr Cost Main-tain	3-Yr Cost Total
1	Modem	IBM	817	135	952	817	405	1222
		DEC	945	192	1137	945	576	1521
2	4 TNE	IBM	967	119	1086	1407	357	1764
		DEC	1095	176	1271	1535	528	2063
3	2 TNE, MUX, OAS	DEC	1264	166	1430	1618	498	2116
4	4 TNE, PCnet LAN	IBM	1068	119	1187	1508	357	1865
5	4 TNE, Corvus LAN	IBM	1046	124	1170	1486	372	1858
		DEC	1174	181	1355	1614	543	2157
6	4 TNE, Sytek LAN	IBM	1090	140	1230	1530	420	1950
		DEC	1218	197	1415	1658	591	2249
7	4 TNE, 3Com LAN	IBM	1132	130	1262	1572	390	1962
8	2 TNE, 3Com LAN, OAS	DEC	1334	169	1503	1688	507	2195
9	2 TNE, Sytek LAN, OAS	DEC	1292	179	1471	1646	537	2183

Also, because of Table 14 space limitations and the large number of configurations considered, a separate Table 14 worksheet has been used for each configuration, whereas many vendors were represented in Table 8. Consequently, the Table 14 worksheets are summarized in Table 15. Table 14 ratings are omitted from Table 15.

Feasible Systems Comparison

Table 16 summarizes the 1- and 3-year cost totals of Table 13. Division of costs by quality points (space provided) would yield cost per quality point on 1- and 3-year bases, corresponding to the last line of Table 8. Given the cost per quality point, it would be possible to rank the configurations on a 1- and 3-year basis. Thus, if 13 configurations were ranked, rank 1 would have the lowest cost per quality point and rank 13 would be highest. The ranking in this study (not shown to avoid endorsement of commercial products) suggested that:

1. Ranks 1 through 6 were insensitive to whether a 1- or 3-year basis was used.

Table 14

System Features Comparison

Feature Subfeature	Point Scoring Procedure	Point Score	Total Points
OAS integration/functionality	(20 max.)		
Ease of entire system use	(0 - 3)		
Fast spooled printing support	(0 or 2)		
Different location printing support	(0 or 3)		
User interface consistency	(0 - 4)		
Local support for large jobs	(0 or 4)		
Degree of existing equipment integration	(0 - 2)		
Integrated system	(0 - 2)		
Third party support	(16 max.)		
Present hardware	(0 - 4)		
Present software	(0 - 4)		
Future hardware	(0 - 4)		
Future software	(0 - 4)		
Vendor support	(16 max.)		
Installation and setup	(0, none; 2, provided)		
Single vendor maintenance	(0, none; 2, available)		
On-site maintenance	(0, remote; 2, depot; 4, on-site)		
Training available: word processing	(0, none; 4, on-site)		
Training available: other PC software	(0, none; 2, available)		
Local electronic mail	(0, none; 2, available)		
Remote access	(15 max.)		
Lines to Tymshare data center (Dallas)	(number of line times 2)		
Connection to TymNet Engine	(0, indirect; 2, direct)		
Batch access (requires file server)	(0, no; 1, yes)		
Access to other than Tymshare	(0, no; 2, yes)		
File transfer	(0, no; 2, provided)		
Word processing	(10 max.)		
Hardware	(0 - 3, subjective est'd)		
Software	(0 - 3, subjective est'd)		
Shared file access	(0, none; 2, available)		
Shared dictionaries, formats, etc.	(0, one; 2, available)		
Local communication	(8 max.)		
High-speed	(0, none; 2, slow coax; 4, fast coax)		
Standard Ethernet	(0, no; 2, yes)		
Asynchronous PC-to-PC communication	(0, no; 2, yes)		
Specialty hardware	(5 max.)		
132-column CRT display	(0, none; 3, available)		
OCR reader, controller, etc.	(0, none; 1, available)		
Laser printer, controller, etc.	(0, none; 1, available)		
Specialty software	(5 max.)		
Tymshare supported	(0, no; 2, yes)		
IBI PC FOCUS available or planned	(0, no; 2, yes)		
IBM PC PROFS available or planned	(0, no; 1, yes)		
Performance	(5 max.)		
Subjective assessment	(0, bad; 5, best)		
TOTAL	(100 max.)		

Table 15

System Features Comparison Summary

System	Configuration	OAS Integration	Third Party Support	Vendor Support	Remote Access	Word Processing	Local Communication	Special Hardware	Special Software	Performance	Total Points
	Value	20	16	16	15	10	8	5	5	5	100
1	IBM (M)										
	DEC (M)										
2	IBM (4 TNE)										
	DEC (4 TNE)										
3	DEC (MUX, OAS, 2 TNE)										
4	IBM (PCnet LAN, 4 TNE)										
5	IBM (Corvus LAN, 4 TNE)										
	DEC (Corvus LAN, 4 TNE)										
6	IBM (Sytek LAN, 4 TNE)										
	DEC (Sytek LAN, 4 TNE)										
7	IBM (3Com LAN, 4 TNE)										
8	DEC (3Com LAN, OAS, 2 TNE)										
9	DEC (Sytek LAN OAS, 2 TNE)										

2. The workstation manufacturer had some effect on both configuration and system ranking, but not nearly as great an effect as did the communication mode.

3. A relatively small additional investment in communications, above what is required for system 2, can improve performance disproportionately, i.e., a far lower cost per quality point.

Software Costs

Software costs are negotiable. Although software vendors would prefer to sell at list, they must protect against making the total cost so great that a large-volume user is tempted to buy a single copy and reproduce it. (Some software is now being produced that self-destructs when an attempt is made to

Table 16

Feasible Systems Comparison (x $1000)

System No.	Communications	PC Vendor	Quality Points	Cost 1 Yr	Cost 3 Yr	Cost/Qual 1 Yr	Cost/Qual 3 Yr	Pt Rank 1 Yr	Pt Rank 3 Yr
1	Modem	IBM		952	1222				
		DEC		1137	1521				
2	4 TNE	IBM		1086	1764				
		DEC		1271	2063				
3	2 TNE, MUX, OAS	DEC		1430	2116				
4	4 TNE, PCnet LAN	IBM		1187	1865				
5	4 TNE, Corvus LAN	IBM		1170	1858				
		DEC		1355	2157				
6	4 TNE, Sytek LAN	IBM		1230	1950				
		DEC		1415	2249				
7	4 TNE, 3Com LAN	IBM		1262	1962				
8	2 TNE, 3Com LAN, OAS	DEC		1503	2195				
9	2 TNE, Sytek LAN, OAS	DEC		1471	2183				

copy it.) One way the vendor can protect the product is to grant (or not grant) a license to copy. If the license to copy is not granted, substantial discounts may be given for large purchases. Most popular software has more than one vendor, allowing price reduction by competition.

The worst case is piecemeal, or single-copy, acquisition. Using requested packages from Table 3, Table 17 shows upper bound software purchase costs. Other software costs are incurred for the required local area networks and OAS. These software costs were included in the hardware procurement prices.

Training

Training is very important when implementing any system. Without timely, quality training, an OA system will be underused. The best possible system will fail if users do not accept it and use it frequently.

Table 17

Upper Bound Purchase Costs--Software

Item	No. Reqd	Unit Cost ($) IBM	Unit Cost ($) DEC	Total Cost ($) IBM	Total Cost ($) DEC
SWP, PC	74	2530	1880	187,220	139,120
SWP, WP	33	954	833	31,482	27,489
SWO	12	474	474	5,688	5,688
Total				224,390	172,297

Training can be pursued in several ways. USA-CERL looked at two in detail--on-site and contractor-site training. Each type has advantages and disadvantages. Advantages of on-site training are: (1) no travel time involved, (2) less expensive, (3) users learn on their own machines, and (4) convenience. The major disadvantage is the distraction that may occur in the office, e.g., telephone calls and visitors. The main advantage to contractor-site training is the lack of distraction. Users can concentrate all their attention on the training class. This advantage may outweigh the numerous disadvantages which include: (1) lease of training site, (2) logistics of moving people from the office to the site, and (3) nonproductive travel time. The option to train on- or off-site is determined by the office environment and, to a lesser degree, by the personnel being trained and subject matter of the course. Another technique becoming popular with both training methods is to allow users to take a computer home and practice in a leisurely setting. This technique has been found to be very effective with supervisors and executive level users.

Final items to consider in training are timing, class size, and follow-up. If training is conducted before the equipment arrives, much of what was learned may be forgotten. Therefore, initial training should be coordinated with equipment arrival. Class size should range from 8 to 12 people. Whether training is conducted on- or off-site, terminals should be available for each user. Two people per terminal is less expensive, but also less effective. The first group to be trained should include managers and supervisors, and their classes should be geared not only toward using the terminal, but also toward managing it. As in any field, computer proficiency is based on familiarity with the system, building on what is learned, and practice. Follow-up sessions are important for this reason, as well as to train new personnel as the result of turn-over. Training cost estimates are based on the following assumptions.

Trainers

The contractor will train personnel to use the new system.

Training Site

Training classes will be at the contractor's office in downtown Washington, D.C.

Number of Trainees

Everyone in OACE will be trained (250 persons) the first year, and about one-third as many each subsequent year. The number of trainees the first year is the authorized strength (232), plus turnover (18), plus 10 from outside OACE, minus 10 within OACE who are not trained for a total of 250.

Course Types

Training will cover word processing and professional use. A few employees may require special-purpose training on equipment other than that in their workstations.

Example Training Plan

The following is a general outline for training. This example is geared toward OACE offices.

Course Length. Training will consist of 40 hours spread over 2 months and will include each type course. The initial session will be 1-1/2 to 2 days, with follow-up sessions for acquiring additional skills, clearing up problems, and exchanging information.

Class Size and Equipment. Each class should have 10 trainees and 1 workstation per trainee. A training room with 12 telephones is required--one for each trainee, one for the instructor, and one additional.

Number of Courses. First year courses should total 26. Five are for 50 word processing trainees, 20 are for 200 personal computer trainees, plus one additional class.

Training Cost. The training is expected to cost $62,500 in the first year for 1250 trainee-days at $50/trainee/day (including course materials). The unit cost of $50/trainee/day corresponds to unit costs under the current Tymshare, Inc., computer services contract, which was awarded competitively. Also, the convention is 1 hr of instruction preparation and paperwork for each hour of instruction. The first year has 1040 hr instruction requiring 2080 total hours (one man-year) instructor time. Thus, $62,500 is not unreasonable for 1 man-year of labor and 50 percent use of a training room. Table 18 is an example of a budget and planning sheet set up in spreadsheet format.

Table 18

Training Budget and Planning Form

DIV	# OF MNGRS	# OF USERS	COST MNGRS TRNG	COST USER TRNG	# PER CLASS MNGRS	# PER CLASS USERS	HR PER CLASS MNGRS	HR PER CLASS USERS	TOT $ MNGRS	TOT $ USERS
ZCZ-A										
ZCA										
ZCE										
ZCF										
ZCH										
ZCI										
ZCM										
ZCP										

6 IMPLEMENTATION

General Considerations

Hardware and software cannot be procured overnight and, even if it could, OACE could not absorb it effectively. Also, it is impossible to make all necessary decisions in advance and to expect good results. Since poor judgment can be expensive, all decisions that can should wait.

Army Regulation (AR) 18-1, Army Automation: Army Automation Management (15 August 1980), procedures apply to OA procurement. AR 18-1 decision authorities of special interest are:

Para. 4a(1)--(Heads of MACOMs may approve) Competitive acquisition of ADP equipment (not to exceed 10 computers per requirement) for general purpose use, total cost of which does not exceed $300,000 purchase or $100,000 annual lease.

Para. 4a(4)--(Heads of MACOMs may approve) Noncompetitive acquisition of ADP equipment (not to exceed 10 computers per requirement), total cost of which does not exceed $50,000 purchase or $18,000 annual lease.

Para. 4b(1)--Division of requirements to avoid limitations is prohibited.

Para. 4b(4)--Up to $70,000 of the authority delegated in Par. 4a(1) and up to $50,000 of the authority delegated in Par. 4a(4) may be redelegated to subordinate commanders of general officer rank.

Specific Considerations

When implementing a system, many details must be worked out in advance to insure a relatively smooth transition. Below are suggestions to follow when planning to install a system. Each of these points will be discussed separately.

- Space available versus space requirements
- Existing furniture
- Power requirements
- Delivery schedule
- Telephone lines
- Network wiring.
- System management.

These points are not in order of importance, but ignoring any one can cause major problems during implementation.

Space

Many civilian and Government offices are crowded, full of 25-year-old furniture, and have documents and records laying around that are no longer needed. Therefore, after all requirements for the OA have been gathered and hardware and software have been selected, consideration must be given to where equipment is going to be placed. Offices may need a different layout or furniture may have to be acquired to hold the new equipment. The first step is to make a floor plan of existing furnishings and personnel locations. Once this is completed, all excess furniture and documents no longer needed must be removed. Sometimes this alone may make room for incoming equipment; however, in most cases, new furniture will be needed to accommodate computers. When this is the case, the office layout will need to be analyzed to insure that work spaces are the proper size and that there is enough room for all equipment. This step should be taken at least 3 months before the equipment arrives; ideally, it should be completed during the same time requirements are gathered.

In USA-CERL's study, space was a major factor, impacting the type of system proposed to a limited degree. OACE's area in the Pentagon was extremely overcrowded and the furnishings did not accommodate ADP equipment very well. Details of the space study are in Appendix A.

Existing Furniture

As mentioned in the last section, furniture is important in implementation. OACE's furniture was standard Government issue 60 x 36 in. (1.5 x .9 m) gray desks with black plastic tops. Several combination safe/file cabinets were found to contain documents no longer used or needed. Also taking up valuable space were bookcases, ranging from metal stack-ups to regular four-shelf wooden types. These were filled with catalogs, loose papers, and assorted books. Secretaries and typists often had two workstations--one for typing (text editing) and a regular desk. This office is typical of those in the Pentagon, with conditions no better or worse than other offices. Since this environment would not accommodate OA equipment, steps had to be taken before the system arrived.

The first step was a major cleanout of all file cabinets and bookcases, discarding unneeded material. Further space was freed by replacing desks with furniture specifically designed for computers. Computer furniture uses vertical space for shelves, allowing room for a personal terminal and desk space to work.

Power Requirements

Many Government buildings are over 30 years old and are not wired to handle modern equipment loads. Therefore, several personal computers can overload the electrical system. OACE's Pentagon office is a perfect example, as an actual power loss occurred from using two computers. The computers, drawing approximately 4 amps of power each, were on but not in operation. These two stations were 30 ft (9.8 m) apart in the same general area. A janitor came into the office and plugged in a vacuum cleaner in an outlet between the two computers, knocking out the lights and the two computers. Fortunately, no data was lost, but the implications of not planning for power requirements are clear.

A workstation outfitted with a printer, modem, personal computer, and monitor will draw about 5 amps. To allow for surges in the electrical system, the required amperage should be doubled.

Delivery Schedule

Since most organizations cannot absorb a large amount of equipment in a short time, AO components must be delivered in phases. Table 19 is an example of an acquisition schedule using conventional government procurement. This table was used in conjunction with Figure 5 to help plan and set milestones for the project.

There are two basic reasons for phased installation of workstations and support equipment. First, breaking up the system delivery results in less office disruption. Second, training can be done on a smaller scale. For example, if the total system calls for 100 workstations, the equipment could be delivered in four installments. Each installment would be made in a 2- or 3-week timeframe with a 1-week period between installments. During the last week of installment and the week between the next one, personnel who have received equipment would be trained.

Figure 6 is a network diagram of the phased implementation technique. The whole system technically is delivered in three phases, with the workstation part of phase 1 being in four installments. Referring back to the network analysis in Figure 5, many details are involved in implementing a system. Table 20 is an example of a way to plot which type of equipment is being delivered, which phases of delivery are occurring, and the estimated date of that delivery. The schedule used at OACE is described in more detail below. Figure 6 outlines a three-phase implementation that is consistent with the above general considerations.

Phase 1--Install some workstations (with software and training), two TymNet engines (remote and local communications), some leased lines, and two laser printers. Acquire some office support hardware and software. Plan to wire for an inactive local area network. Retain the two existing Tektronix 4052 keyboard/printers and 4662 Multi-Pen Plotters to provide short-term, medium-size plotter capability. Begin gradually phasing out existing equipment, as discussed in Appendix B.

Phase 2--Install more workstations and activate the local area network.

Phase 3--Install all remaining equipment planned, as well as any unplanned equipment deemed necessary for a complete system.

Figure 5 is an activity network consistent with Figure 6. Table 21 contains full activity network descriptions. In Figure 5, nodes G, J, and M mark the beginning of user operation within phases 1, 2, and 3.

Figure 5 time periods are approximate and depend on myriad actions that cannot be forecast with precision. Some actions will become known only as the implementation progresses. For example, nodes J and M are major decision points affecting overall system configuration. Many agreements must be negotiated both within the Government and between the Government and private firms; in effect, this schedule must be meshed with others' schedules.

Table 19

Acquisition Schedule Example

Milestones	Day	Target Date for Completion
Received approval from DAEN-RMI		27 Oct 83
Funding site approved from DAEN-ASM		4 Nov 83
Delegation of procurement authority by Baltimore District	1	5 Nov 83
3953 and justification for noncompetitive acquisition to Baltimore	1	5 Nov 83
Contract specifications delivered to Baltimore District	1	5 Nov 83
Contract written, noncompetitive	10	10 Nov 83
Contract awarded	27	25 Nov 83
First installment of equipment	69	3 Jan 84
Second installment of equipment	84	17 Jan 84
Third installment of equipment	99	31 Jan 84
Final installment of equipment	114	14 Feb 84

The first activity, procurement paperwork following system concept approval, requires an initial decision on whether to proceed with one large procurement or several small ones. A case can be made for office-by-office acquisition of workstations over a 2-year period, using OCE's (MACOM) authority under AR 18-1. Appendix E gives a typical request for approval of noncompetitive acquisition of workstations. Contract No. DACW31-82-C-0015 provides the authority to acquire equipment for communications (such as TymNet engines) from Tymshare, Inc.

Telephone Lines

Telephone lines include more than the networks running from pole to pole along the highway. In this study, telephone lines are any twisted-pair wires used for communication, such as those inside the building. Many of these lines should be in place before the equipment arrives. For the OACE system, twisted-pair wires (telephone lines) had to be run from selected workstations to the Tymnet Engines. OACE also needed phone jacks for auto-dial modems to back up the Tymnet Engines; these were planned to be in place when the equipment arrived.

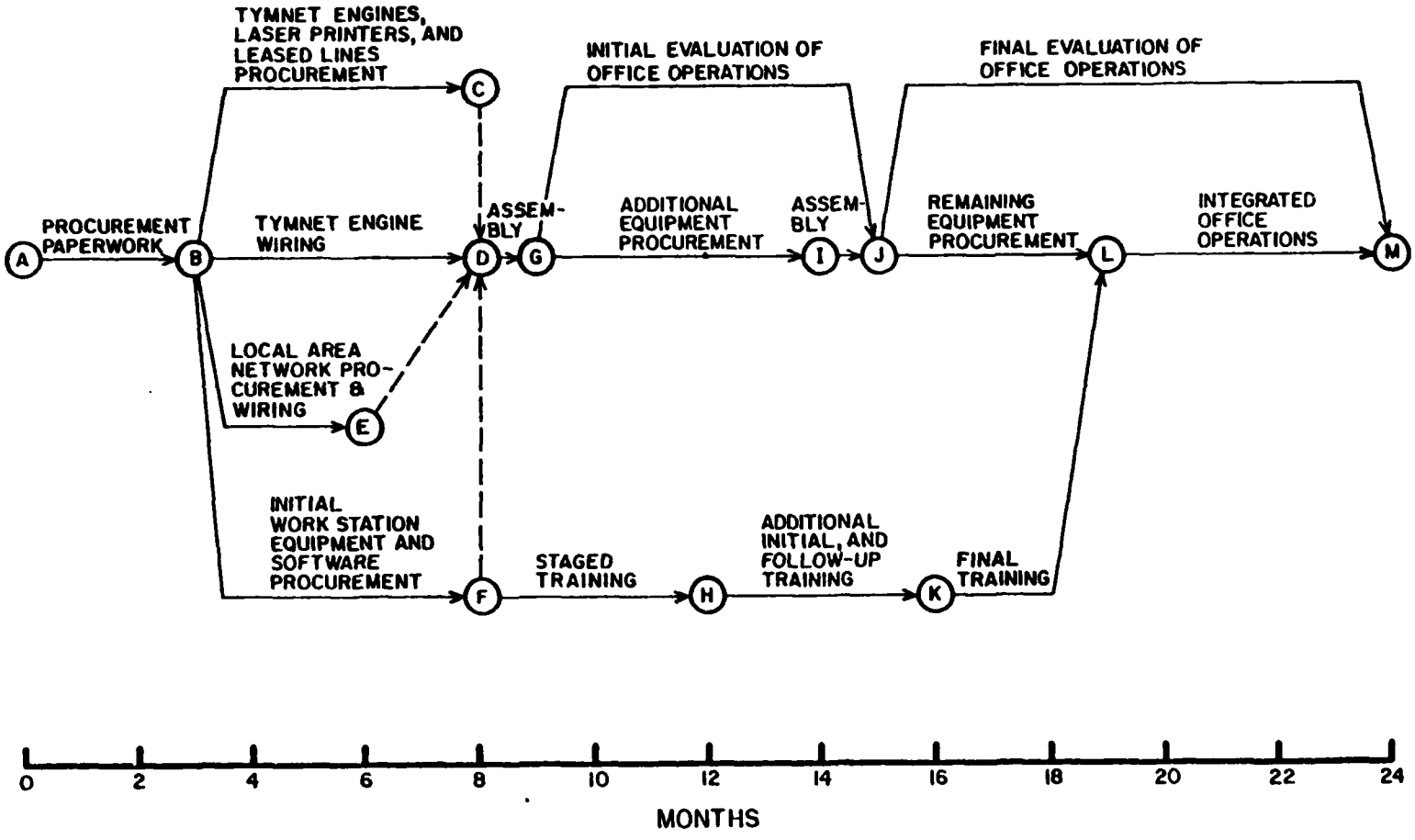

Figure 5. Outline of implementation plan.

Table 20

Workstation Delivery Data Form

Phase:	Installment #:					Delivery Date:	
	P1	P1C	P2	P2 SER	P2T	P2C	PLOTTER
ZCZ-A							
ZCA							
ZCE							
ZCF							
ZCH							
ZCI							
ZCM							
ZCP							
ZCP-C							
ZCP-M							
ZCP-R							
ZCP-U							
ZCR							
Totals							

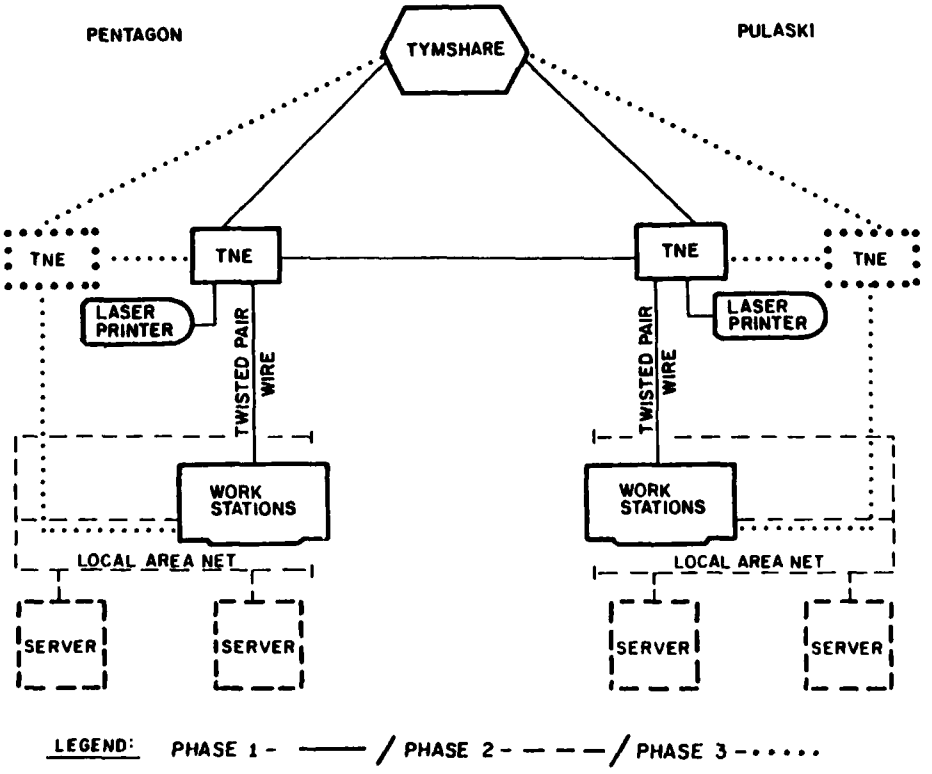

Figure 6. Phased office automation implementation concept.

Table 21

Implementation Activities List

Activity	Description
A-B	Procurement paperwork following system concept approval
B-C	TNE, laser printers, and leased lines procurement
B-D	Twisted-pair wire procurement for both buildings and installation
B-E	LAN and LAN accessories procurement for both buildings and installation
B-F	Initial individual workstation equipment and software procurement
C-D	Dummy
E-D	Dummy
F-D	Dummy
D-G	Assembly and installation of initially ordered equipment
F-H	Staged training on assembled initial order
G-I	Additional equipment procurement
G-J	Initial evaluation of office operations
H-K	More initial training and follow-up training
I-J	Assembly and installation of additional procurement
J-L	Remaining required equipment procurement
J-M	Final evaluation of office operations
K-L	Final training
L-M	Integrated office operations

Dedicated leased lines should not be installed too far in advance of workstation arrival because an expensive monthly leasing charge is paid whether or not they are working. Leased lines are not necessary unless an organization has a high volume of data moving back and forth between a remote data base. The OACE data base in Dallas, TX, has the high volume to justify leased lines; each line costs approximately $1500 per month.

Local Area Network Wiring

LANs can be wired several different ways, depending on the type of wire and type of LAN configuration used. If a broadband network with a central server is chosen, the wire can be installed before the equipment arrives. For a baseband network with distributed servers, advance wiring is not necessary. In either case, a floor plan showing workstation location is required, particularly if wire is laid in advance.

System Management

Earlier systems were managed centrally by individuals who spent their day hovering over the mainframe in the computer room. However, with the advent of the personal computer came a new concept called "distributive management," which can be defined as decision-making at a lower level. With this definition in mind, a review of Figure 6 shows the absence of any mainframes, minis, or other related pieces of equipment. Each OACE division and, in some cases, office was provided a microcomputer that operates as a local server. These servers are not dedicated, because they also operate as user stations. This allows many decisions concerning the system to be made at a division level, rather than through a central location. Thus, each division or office can make minor refinements to the basic system to satisfy specific requirements without upsetting the entire system's integrity.

One person--the project manager--is still responsible for keeping the entire system upgraded and protecting its integrity. In addition, implementation takes much planning, work, and coordination with using offices, approving offices, vendors, maintainers, and trainers. The project manager also should take charge of this responsibility. OACE's project manager would come from DAEN-ZCR.

The project manager's duties are complex and can be further complicated by two factors. First, if there is more than one system vendor for all hardware, software, maintenance, and training, the vendor selection and coordination is a major task. Second, if very many small procurements are required, the paperwork can become formidable. The project manager's duties include:

1. Procure system hardware/software/communications (HSC)

2. Assist OACE offices in procuring office HSC

3. Procure and manage the system support contractor(s) for HSC installation, operation, maintenance, and training

4. Periodically reassess HSC and training requirements--define changes and see them carried out

5. Manage system financing and finances

6. Identify changes to supporting data systems that will make integrated office operation more effective

7. Collect and disseminate OA information of general interest

8. Acquire and maintain personal (project manager) HSC technical proficiency

9. Serve as OA point of contact for OACE and for organizations interacting with OACE.

Temporary project managers must also procure and train a permanent project manager.

7 RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Results

Table 22 summarizes study findings on existing and ordered equipment and items required for system configurations containing TymNet engines. Leased lines vary in number and are acquired as needed; those are not shown. Table 22's bottom line gives the total requirement for workstations and support equipment for 232 total employees served.

Table 16 contains 1- and 3-year costs for the nine systems (13 different system configurations) evaluated. The 1- and 3-year bases were used because it was necessary to mix one-time purchase costs with annual costs in the computations. It was found that the higher performance systems' cost per quality point (cost/benefit) was not influenced by the number of years costed. The workstation vendor choice had a minor influence on system ranking. The most important finding was that the relatively small incremental cost increase for high performance produces a dramatic drop in the cost per quality point.

A three-phase implementation plan was prepared to move immediately from the modem-based present configuration (system 1) to a TymNet engine-based configuration (system 2), and then gradually move into a TymNet engine/local area network communication arrangement (tentatively system 7). It is estimated that the addition of a local area network (moving from system 3 to system 7) can increase performance 50 percent at only an 11 percent cost increase.

Conclusions

It is possible to provide user responsive, high-performance, office automation at a reasonable cost (less than 6 percent of labor and labor-related costs). With a proper plan, large-scale, integrated office automation can be introduced gradually without major upheaval or high initial cost. Such a plan would allow for downstream performance evaluation, decision-making, correction, redesign, and fine-tuning of acquisition, training, operation, and maintenance.

OACE requires a wide array of office automation equipment integrated as a system. No one system or component assembly is practical for meeting OACE's needs; several alternative systems must be designed, costed, and evaluated for performance before selection can be made. In addition, good management skills will be needed to run OACE's new automated system.

Recommendations

It is recommended that the last line of Table 22 be accepted as an initial framework for total requirements at OACE (the numbers may increase or decrease). Moreover, it should be recognized that the system (personnel and equipment) will require up to 2 years after approval to attain full design operational objectives.

Table 22

Major Hardware Quantities

	Workstation			Office				Building					
	Total	P[1]	W	U	PCP	U	PLS	CGP	LP	PLM	OCR	TNE	LAN
Existing and ordered													
On hand	54	8	11	35		3	1			2			
Baseline	26	17	5	4	5	4	3	3					
Baseline total	80	25	16	39	5	7	4	3		2			
On-hand retention	19			19		3	1						
Required (1st analysis)													
Test procurement	65	29	28	8	7	4	8	9	2	2	1		
Test equipment	77	29	28	20	7	7	8	9	2	2	1		
Total requirement	129	63	33	33	7	7	9	13	2	2	2		
Required (2nd analysis)													
Test procurement	85	53	23	9	7	4	8	6	2			2	2[2]
Test equipment	100	53	23	24	7	7	9	6	2	2		2	2[2]
Total requirement	139	75	33	31	7	7	9	6	2	2	2	4	2

[1]P = professional; W = word processing; U = unintelligent terminal; PCP = personal computer, portable; U = unintelligent terminal; PLS = plotter, small size; CGP = color graphics printer; LP = laser printer; PLM = plotter, medium size; OCR = optical character reader; TNE = TymNet engine; and LAN = Local area network.
[2]Wired, but inactive.

APPENDIX A:

EQUIPMENT SPACE CONSIDERATIONS

Workstations

Figures A1 through A3 show typical measurements for professional (personal computer), word processing, and unintelligent terminal workstations and their equipment components. Not all workstations contain all components shown in the diagrams. Table A1 translates the figures to existing and required workstation configurations and required desk space. The square footages shown are approximate. The following assumptions were made in Table A1:

- No aisle space is required
- Existing stations are configured as shown in Figures A1 thrugh A3
- Existing stations have modems except for slaved word processing
- Required stations have no modems
- Total space required is the product of the maximum station width and length, and includes lost desk space. For example: a required P2 (Figure A1 less modem) is 34 in. wide and 24 in. deep (.85 x .60 m); sq ft 34 x 24 ÷ 144 = 5.7 sq ft (.85 x .60 = .51 m^2).

Because of these approximations, the existing and required areas may be under- or overstated. For example, the DAEN-ZCF-R MarkLink system is not configured as calculated and requires 100 sq ft (9.2 m^2) rather than the 36 sq ft (3.3 m^2) calculated. However, the greatest errors occur on existing equipment to be retained and have no effect on net space required. The ordinary desk area is 34 by 60 in., or 14.17 sq ft (.85 by 1.5 m; 1.3 m^2). Thus, the computed 419 sq ft (38.6 m^2) net increase corresponds to 30 desks. It can be argued that office automation equipment should offset overall paperwork (and paper storage), so that actual space requirements change little.

Approximate workstation component weights are (lb):*

Personal computer	35
Word processor	50
Keyboard for the above	6
Modem	8
Monitor	19
80/132 character printer	12
156 character printer	37
220 character printer	45

Office Equipment

There are 29 small portable items: seven personal computers, seven unintelligent terminals, nine small plotters, and six color graphics printers. These items tend to float and, when not in use, are tucked away under desks or in or on cabinets. Thus, their space requirements are negligible.

*1 lb = .45 kg.

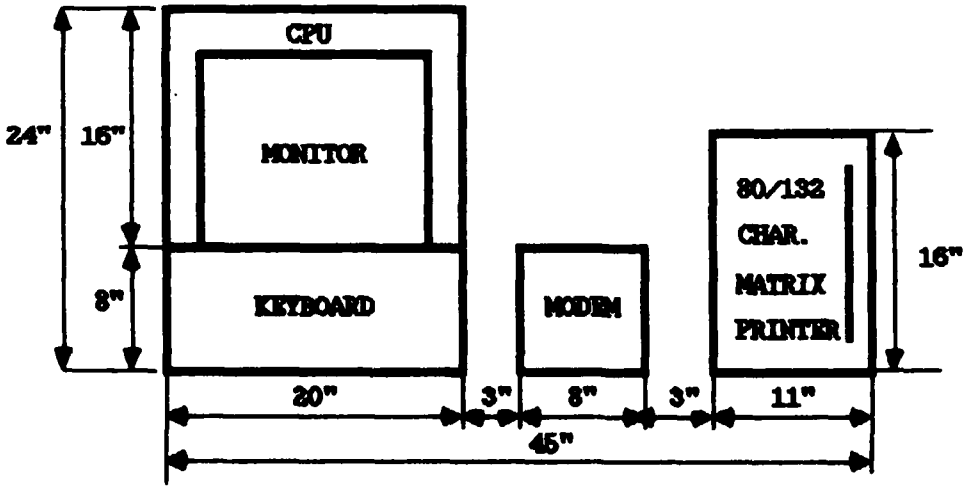

Figure A1. Typical dimensions for a professional workstation with a 80/132 character printer and modem.

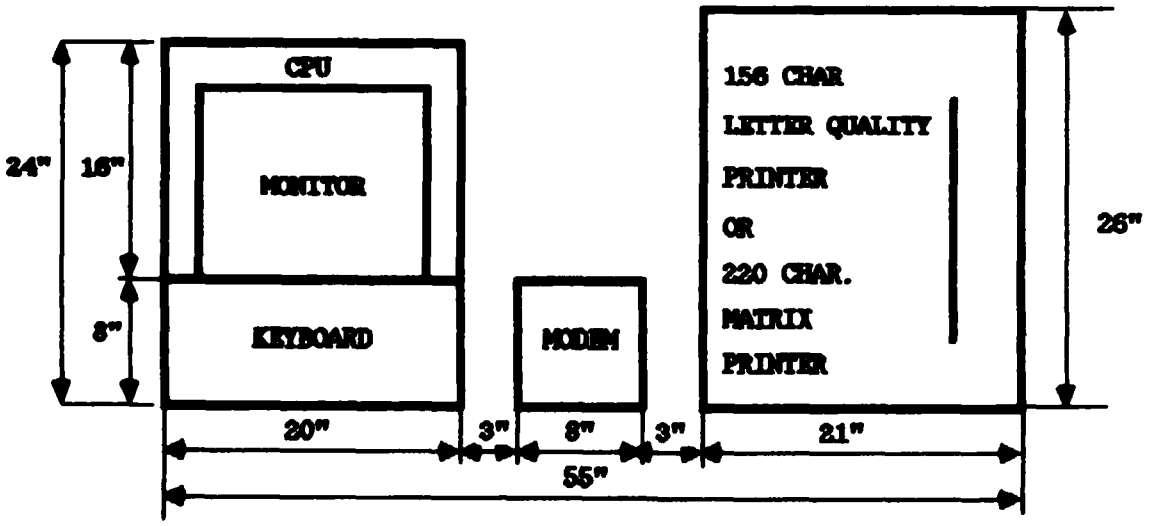

Figure A2. Typical dimensions for a word processing workstation with a printer or a professional workstation with a 220 character printer and modem.

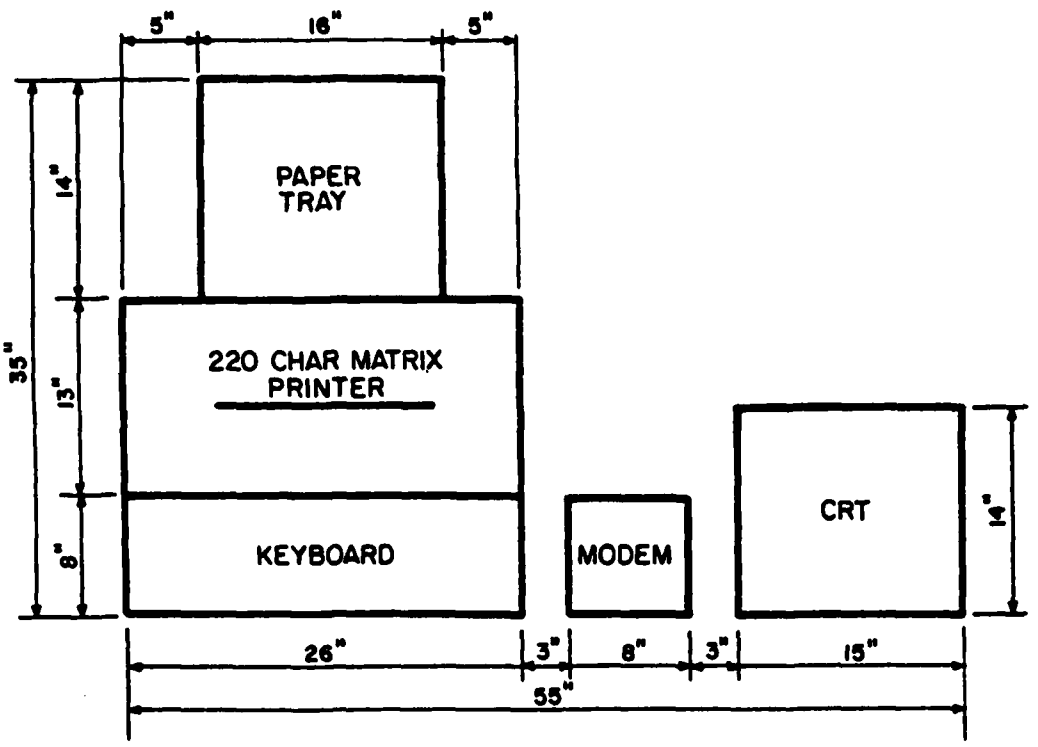

Figure A3. Typical dimensions for an unintelligent keyboard/printer terminal with paper tray, modem, and CRT.

Building Equipment

Fifteen items of space-consuming building equipment are divided almost equally between the Pentagon and the Pulaski Building. These include two laser printers, two medium-size plotters, two optical character readers, four TymNet engines, and five (3Com assumed) local area network servers.

Installation of many workstations at or near the principal user's desks allows the following space reductions in locations formerly occupied by commonly used terminals:

Pentagon

Rm 1D676	170 sq ft (15.9 m^2)
Rm 1E677	90 sq ft (8.3 m^2)

Pulaski Bldg

Rm 2219	135 sq ft (12.4 m^2)
Rm 2221C	40 sq ft (3.7 m^2)

Approximately 170 sq ft (15.9 m^2) are required for one-half the equipment. Thus, Rooms 1D676, 2219, and 2221C satisfy the 170 sq ft (15.9 m^2) per building need. Room 1E677 usage can remain unaltered.

Table A1

Existing and Required Workstations Desk Space (sq ft)[1]

Status Type	Figure	Less	Unit Space	No. Items	Items Space	Total Space
Existing stations				(54)		
P, P1	D-1		7.5	4	30	
PT, P1T	D-2		10.0	11	110	
P1T*	D-2	Modem, printer	3.4	4	14	
U, U1	D-3	CRT	9.0	33	297	
U2	D-3		13.4	2	27	478
Required stations			(139)			
P, P1, P1C, P2, P2C	D-1	Modem	5.7	70	399	
PT, P2T	D-2	Modem	8.0	30	240	
P2T*	D-2	Modem, printer	3.4	8	27	
U, U1	D-3	Modem, CRT	6.3	23	145	
U2	D-3	Modem	10.7	8	86	897
Net Space Increase						419

[1]Metric conversion: 1 sq ft = .092 m^2.

APPENDIX B:

EXISTING WORKSTATION FEATURE

Raw Data

Figure B1 contains coding symbols used in the raw data collected for this study. Equipment physical characteristics were obtained by inventory, and equipment usage was obtained through interviews. Figure B2 is an example of a data sheet that lists the last names and first initials of personnel.

Analysis

Table B1 lists 57 existing workstations by office and equipment type. These 57 include the 54 shown in the "Existing and ordered/on hand" column of Table 3 plus three on-hand portable unintelligent terminals. Table B1 also shows the Government investment and ownership along with comments on usefulness, which affects retention. This table gives a potential FY84 and FY85 plan for managing the equipment. Table B2 summarizes the same information by equipment type.

Conclusions

The TI OMNI 820 KSRs definitely should be retained. Some Government-owned equipment (Teletype 43s, TI Silent 745s, and one or more OMRONs) also will be retained. The MarkLink system will be kept until an adequate replacement is found. All other equipment will be replaced and phased out by returning it to the owner, surplusing, or not renewing leases.

FUNCTION
P = Professional computer (intelligent, programmable terminal with main [primary] memory, and usually secondary [disc, floppy or hard] memory)
U = Unintelligent terminal
W = Word processor terminal
G = Graphics terminal

LOCATION
Office Branch and section symbols
Room Last three digits (e.g., 219 for Pulaski Bldg, Room 2219)
Area First and last initials of nearest employee,
Vac for vacant position,
Con for contractor employee,
Comp for computer room, or
Ent for entrance

COMPONENTS
Printer
Quality
R = Readable
G = Good
C = Correspondence
L = Letter
Element
T = Thermal
M = Matrix
D = Daisy wheel
B = Ball
C = Chain- or belt-driven

SUPPORT HARDWARE
Plotter (size)
S = Small, 8-1/2 x 11 in.
M = Medium, 11 x 17 in.
L = Large, 28 x 40 in.

SUPPORT SOFTWARE
Operating system
DOS = Disc operating system
TRS = Tandy Radio Shack DOS
CP/M = Control program for microprocessors
DBMS (none, one, or more than one of the below)
F = FOCUS
X = General purpose
Compilers (none, one, or more than one of the below)
B = Basic
F = FORTRAN
C = COBOL
P = Pascal
p = UCSD p-System

USERS
First and last initials of employee,
Vac for vacant position,
Con for contractor employee,
Other for other, or
Gen Use for general use (add Port for portable).

Figure B1. Workstation requirements symbols.

Office	Position	Auth. Grade	Incumbent	Room	Workstation Req'd	Pilot Test
		ASSISTANT CHIEF OF ENGINEERS				
ZCZ-A	Asst Ch Engrs	GO 08	Delbridge, N.	1E668	P2C	x
ZCZ-B	Dep to the Asst Ch of Engrs	GO 07	Hilmes, J.		P1C	
ZCZ-C	Dep to the Asst Ch of Engrs	ES 05	Carton, A.		P1C	
ZCZ-X	Exec Dir	EN 06	Clark, G.		P1C	
ZCZ-X	Exec Off	EN 05	Murphy, W.		P2	x
ZCZ-A	Secy (Steno)	GS 09	Froelich, G.		P2T*	
ZCZ-A	Secy (Steno)	GS 08	Anderson, B.		P2T	x
ZCZ-A	Secy (Steno)	GS 08	Vacant		P2T	
ZCZ-X	Admin Specialist	NC E7	Vacant			
		ARMY ENVIRONMENTAL OFFICE				
ZCE	C Environ Off	EN 06	Halleran, K.	1E676	P1	x
	San Engr	MS 05	Stone, S.		P1	x
	Engr Staff Off	EN 04	Colio, L.		P1C	
	Environ Prot Sp A	GM 14	Palmer, D.		P1	x
	Environ Prot Sp B	GM 14	Robinson, G.		P1	
	Environ Prot Sp A	GM 13	McGee, M.		P1	
	Environ Prot Sp B	GM 13	Vacant			
	Prog/Anal	GS 12	Vacant		P1C	x
	Secy (Steno)	GS 06	Everett, P.		P2T*	x
	Clk (Typ)	GS 05	Glenn, P.		P2T*	x

Figure B2. Workstation and personnel data form example.

Table B1

Two-Year Plan for Existing Workstations

Off	Work Station	Item	% Paid	Action[1] FY 84	Action[1] FY 85	Comment
ZCZ	1U	hp 444KB	0	R	-	Borrowed
ZCE	2U	DEC VT 125,...	0	R	-	Borrowed from USA-CERL
	3W	Olympia 100,...	0	R	-	On hand receipt from DA staff
ZCI	1W	NBI 3000,...	50	RS	-	Excellent, expensive, nonstandard
	2W	NBI 3000,...	50	RS	-	Excellent, expensive, nonstandard
	3U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	4U	Teletype 43	0	R	-	Borrowed from FESA
	5U	WWMCCS	0	-	R	Provided by Command & Control Support Agency
	6U	WWMCCS	0	-	R	Provided by Command & Control Support Agency
ZCP Pnt	1W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	2W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	3U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	4G	Tektronix 4052/4662	0	R	-	Replace with plotter only
	5U	OMRON 8025G24	100	RS	-	Mismatched OMRON and TI 810
		TI OMNI 810 RO	50	K	CK	Excellent, inexpensive
	6U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	7U	OMRON 8025G24	100	RS	-	Inadequate, inaccurate
ZCP Pul	1P	DEC Rainbow 100,...	0	K	R	Borrowed
	2	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	3U	GE TermiNet 30,...	100	S	-	Antiquated
	4U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	5U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	6W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	7W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	8U	GE TermiNet 30	100	S	-	Antiquated
	9U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	10U	TI Silent 745	100	K	K	Adequate, portable
	11U	TI Silent 745	100	K	K	Adequate, portable
	12U	TI Silent 745	100	K	K	Adequate, portable
	13W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	14U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	15U	OMRON 8025G24	100	K	-	Adequate
	16P	Tymshare 1100,...	0	R	-	Borrowed from DAEN-ECC-C
	17G	Tektronix 4052/4662	0	R	-	Replace with plotter only
	18U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive

[1] C = complete purchase, K = keep in OACE, R = replace, S = surplus.

Table B1 (Cont'd)

ZCF	1U	Teletype Model 43	100	K	K	OK, 8-1/2 in. between perforations
	2P	TRS 80 Model II,...	0	R	-	Need TRS 80 Model 12
	3U	Teletype Model 43	100	K	K	OK, 8-1/2 in. between perforations
	4P	TRS 80 Model II,...	0	R	-	Need TRS 80 Model 12
	5P	TRS 80 Model II,...	0	R	-	Need TRS 80 Model 12
	6U	TI 911 Video Terminal	0	K	K	Excellent, dedicated to ZCF-R
	7U	TI 911 Video Terminal	0	K	K	Excellent, dedicated to ZCF-R
	8P	TRS 80 Model II,...	0	R	-	Need TRS 80 Model 12
	9U	TI 911 Video Terminal	0	K	K	Excellent, dedicated to ZCF-R
	10U	Teletype Model 43	100	K	K	OK, 8-1/2 in. between perforations
	11U	TI 911 Video Terminal	0	K	K	Excellent, dedicated to ZCF-R
	12P	TRS 80 Model II,...	0	R	-	Need TRS 80 Model 12
ZCH	1W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	2W	NBI 3000,...	75	RS	-	Excellent, expensive, nonstandard
	3U	Teletype Model 43	0	K	R	Borrowed
	4P	Apple II	0	R	-	Borrowed
	5U	Dasher d200,...	0	K	K	Borrowed
	6U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive
	7W	Compustar Model 30,...	75	CK	K	Excellent
	8U	TI OMNI 820 KSR	0	R	-	Allow DAEN-ECE-A full use
	9U	OMRON 8025G24	100	K	RS	Inadequate
	10U	DEC VT132	100	K	RS	Inadequate
	11U	TI OMNI 820 KSR	50	K	CK	Excellent, inexpensive

Table B2

Summary Plan for Existing Equipment, by Type

1. Type: TI OMNI 820 KSR keyboard/printers
   Stations(12): ZCI3U, ZCP3U (Pnt), ZCP6U (Pnt), ZCP2U (Pul), ZCP4U (Pul), ZCP5U (Pul), ZCP9U (Pul), ZCP14U (Pul), ZCP18U (Pul), ZCH6U, ZCH8U, ZCH11U.
   Disposition: Excellent. Leased, with option to purchase. Half paid, retain, and purchase. Twelve on hand (but station ZC8U fully reverts to DAEN-EC-A); 12 are required.

2. Type: NBI System 3000 word processors
   Stations (9+2): ZCI1W, ZCI2W, ZCP1W (Pnt), ZCP2W (Pnt), ZCP6W (Pul), ZCP7W (Pul), ZCP13W (Pul), ZCH1W, ZCH2W, (DAEN-ECE-S, Dual Station).
   Disposition: Excellent. Leased with option to purchase. Seven (three dual and one stand-alone station) on hand are three-fourths paid, two (dual station) on hand are one-half paid, and two (dual station) being returned by DAEN-ECE-S have unknown ownership. These stations are expensive, have added capabilities not required in an integrated system, and will not be standard for OACE. The Government should acquire ownership and assign where needed. All are to be replaced eventually, but some will be retained while changing to the new system.

3. Type: TRS 80 Model II microcomputers
   Stations (5): ZCF2P, ZCF4P, ZCF5P, ZCF8P, ZCF12P.
   Disposition: Inadequate. Leased, no option to purchase, to be replaced by TRS 80 Model 12s.

4. Type: Teletype Model 43 keyboard/printers
   Stations (5): ZCI4U, ZCF1U, ZCF3U, ZCF10U, ZCF3U.
   Disposition: Adequate, Government-owned. The ZCI station is to be returned to FESA immediately; the ZCH system is to be returned to FESA after 1 year. ZCF will retain its stations but is unsatisfied with printer paper which is 8-1/2 in. between perforations rather than 11 in.

5. Type: MarkLink (TI 911) video terminals, processor, disc drive, Printer
   Stations (4): ZCF6U, ZCF7U, ZCF9U, ZCF12U.
   Disposition: Excellent. Leased, no option to purchase, to be retained.

6. Type: OMRON 8025G24 keyboard/CRT
   Stations (4): ZCP5U (Pnt), ZCP7U (Pnt), ZCP15U (Pul), ZCH9U.
   Disposition: Adequate to inadequate. Government-owned. The ZCP15U (Pul) station is to be retained. ZCP5U (Pnt) and ZCP7U (Pnt) are to be replaced and surplused immediately. (ZCP7U [Pnt] may require minor maintenance before surplusing.) ZCH9U is to be retained 1 year and then surplused.

Table B2 (Cont'd)

7.	Type:	TI Silent 745 portable keyboard/printer.
	Stations (3):	ZCP10U (Pul), ZCP11U (Pul), ZCH12U (Pul).
	Disposition:	Adequate. Government-owned, retain.
8.	Type:	GE TermiNet 30 keyboard/printer, with tape cartridge I/O
	Stations (2):	ZCP3U (Pul), ZCP8U (Pul).
	Disposition:	Antiquated. Government-owned, surplus.
9.	Type:	Tektronix 4052 keyboard/printer and 4662 multi-pen plotter
	Stations (2):	ZCP4G (Pnt), ZCP17G (Pul).
	Disposition:	Adequate. Leased without option to purchase. These stations are expensive and the stand-alone keyboard/printers will no longer be required. The existing plotters will be replaced by new plotters linked to all workstations.
11.	Type:	WWMCCS keyboard/CRT/printer
	Stations (2):	ZCI5U, ZCI6U.
	Disposition:	Inadequate, provided by Command and Control Support Agency. To be upgraded.
12.	Type:	TI OMNI 810 RO printer
	Stations (1):	ZCP5U (Pnt).
	Disposition:	Excellent. Leased with option to purchase. One-half paid, retain and purchase. A use can be found somewhere within OACE for a read-only printer driven from the CPUs or a keyboard/CRT.
13.	Type:	DEC VT 132 keyboard/CRT
	Stations (1):	ZCH10U.
	Disposition:	Adequate to inadequate. Government-owned, retain 1 year, then replace and surplus.
14.	Type:	Compustar Model 30 word processor
	Stations (1):	ZCH7W.
	Disposition:	Excellent. Leased, with option to purchase. Three-fourths paid, retain and purchase. May be kept permanently.
15.	Type:	Dasher d200 keyboard/CRT/printer
	Stations (1):	ZCH5U.
	Disposition:	Adequate to inadequate. Provided by Defense Housing System Office to access its data base. However, the workstation has not functioned successfully as a general purpose terminal to access other data systems. Try to replace with a general purpose personal computer that will serve all desired purposes.
16.	Type:	DEC Rainbow 100 personal computer
	Stations (1):	ZCP1P (Pul).
	Disposition:	Adequate. Borrowed, retain 1 year and replace.

APPENDIX C:

FLOOR PLANS

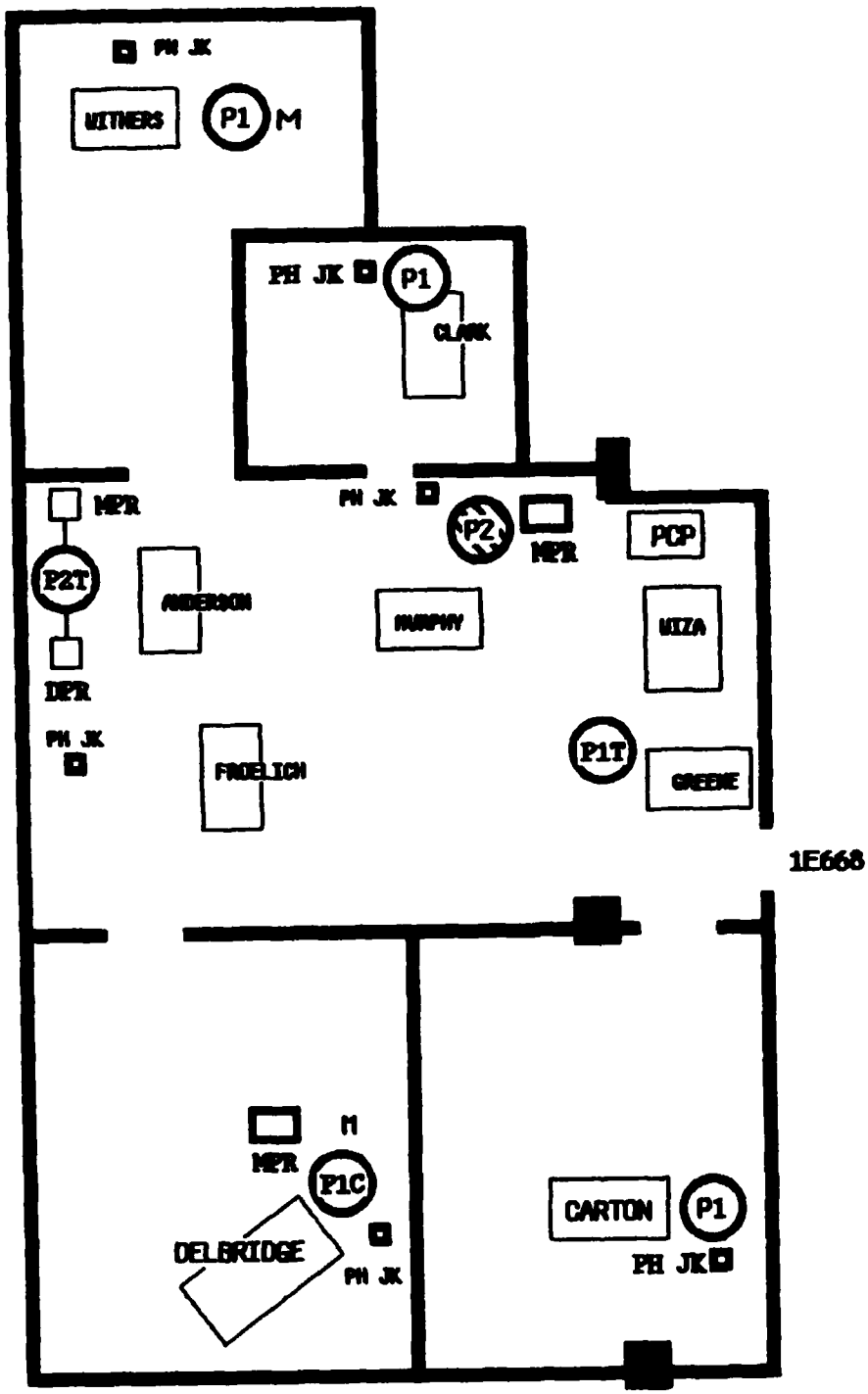

Figure C1. DAEN-ZCA-A workstation layout.

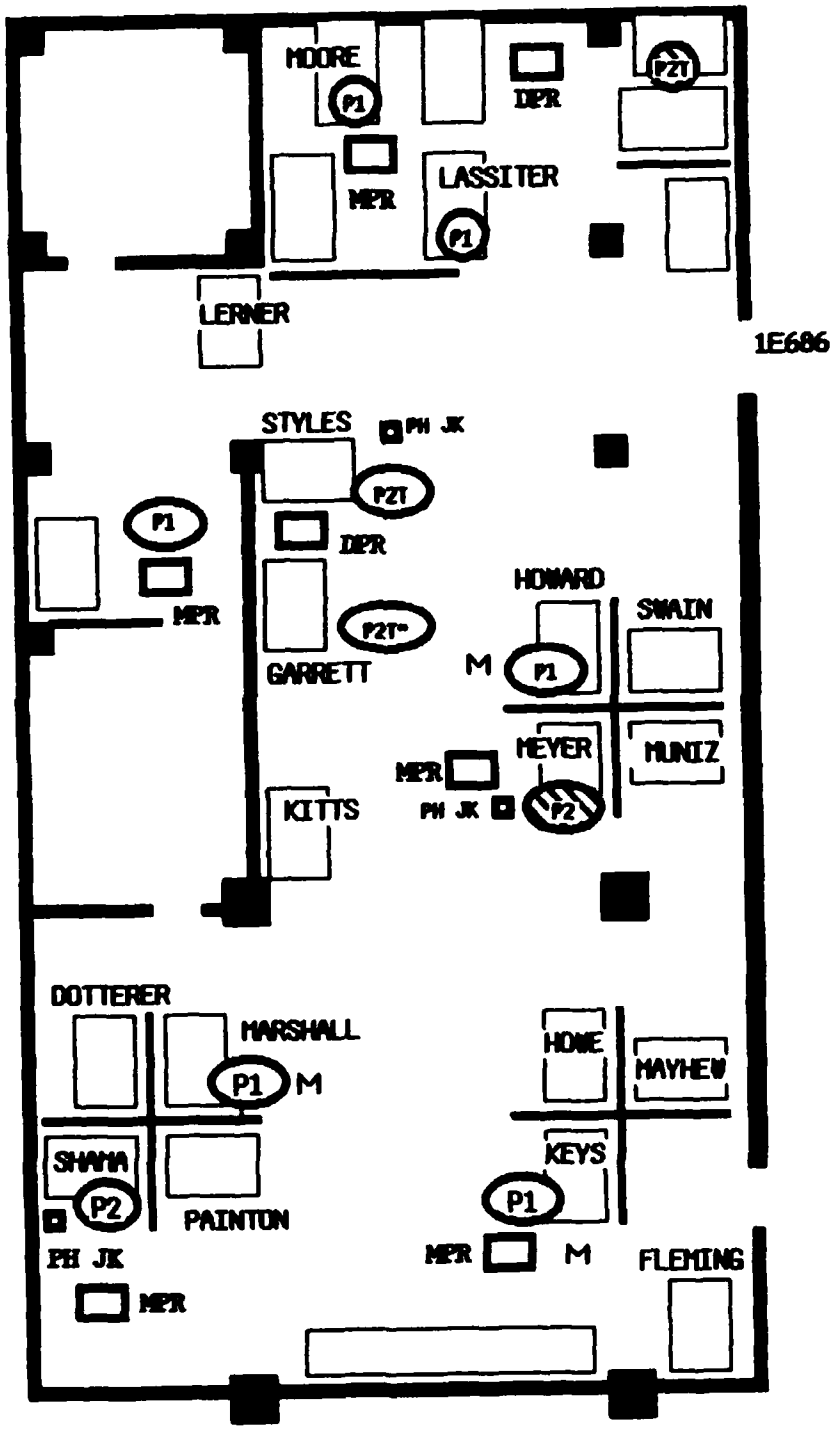

Figure C2. DAEN-ZCA/ZCM workstation layout.

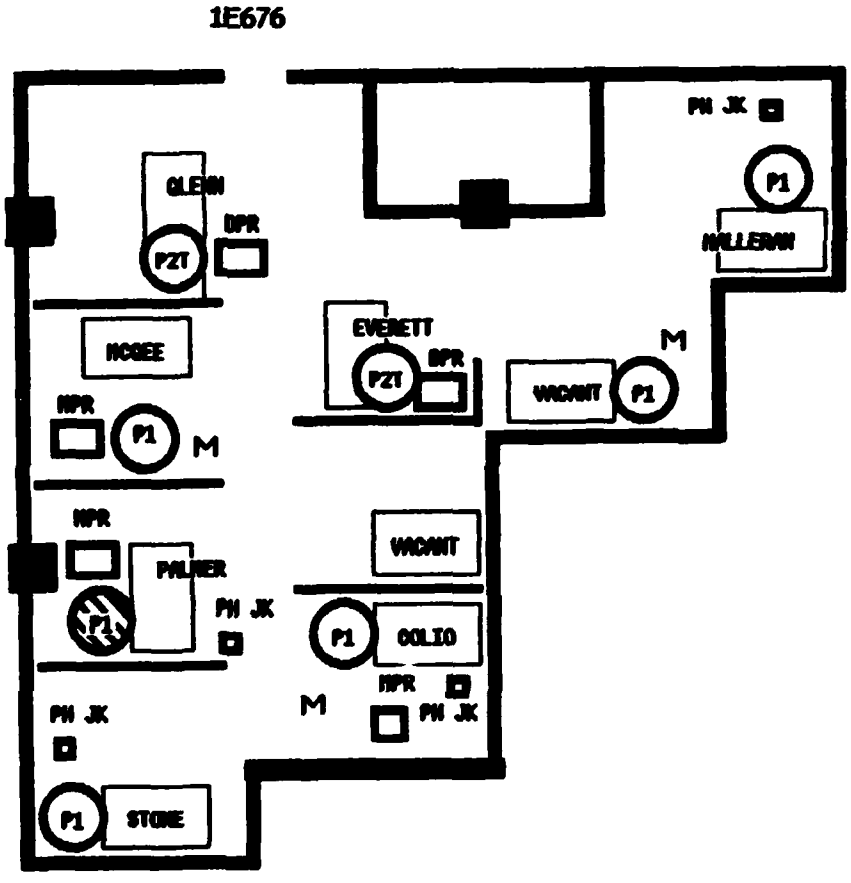

Figure C3. DAEN-ZCE workstation layout.

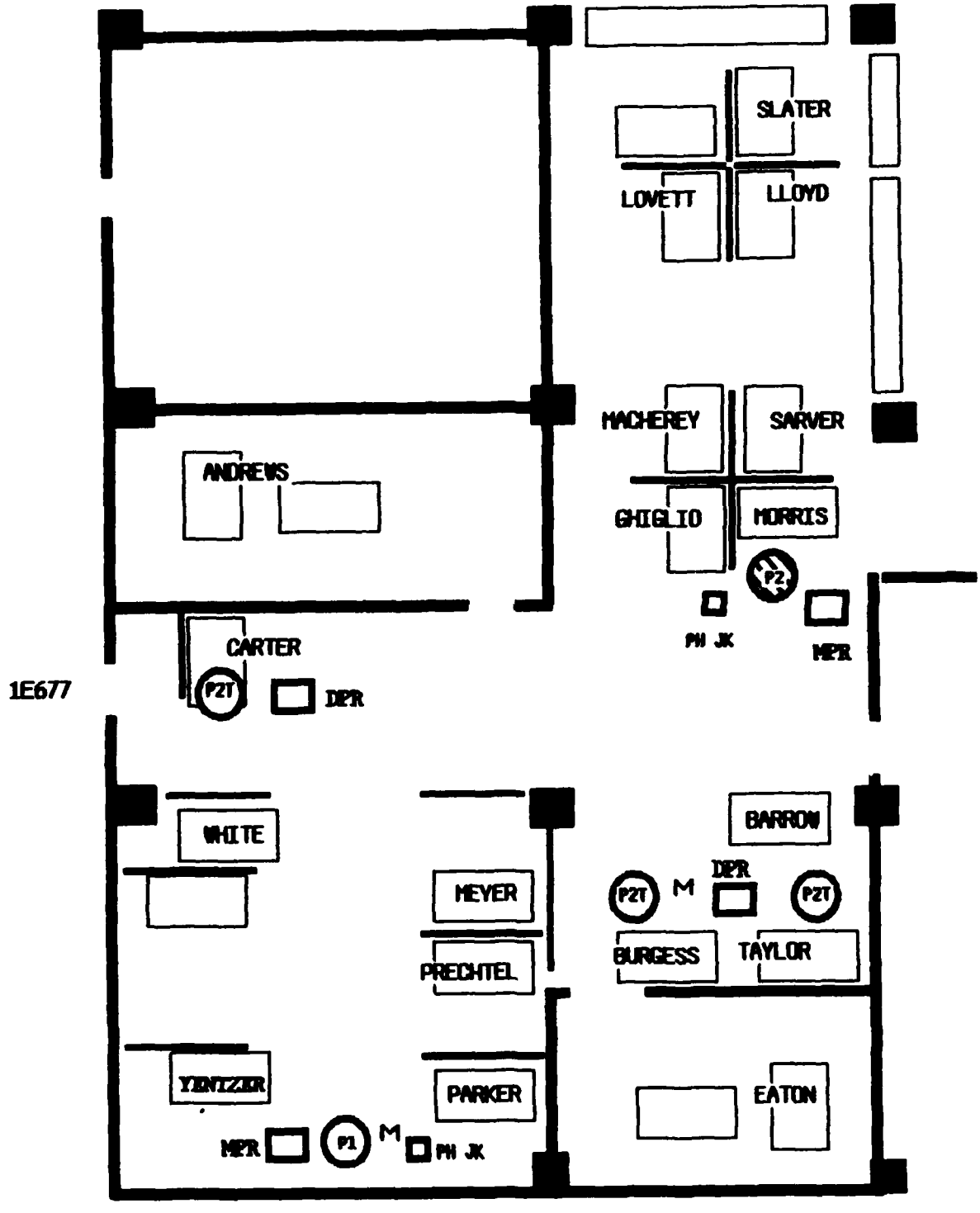

Figure C4. DAEN-ZCI workstation layout.

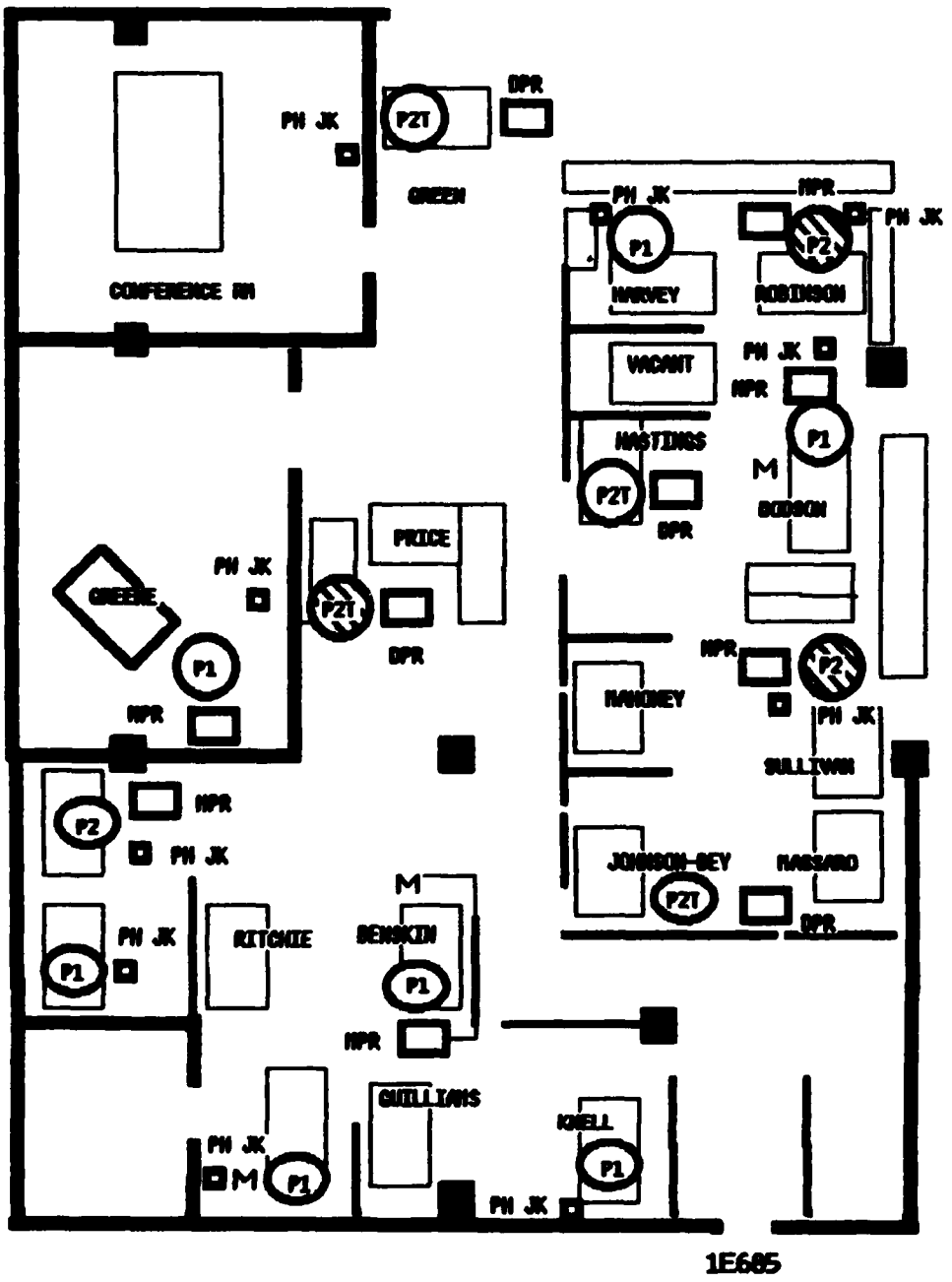

Figure C5. DAEN-ZCP/-C/-R workstation layout.

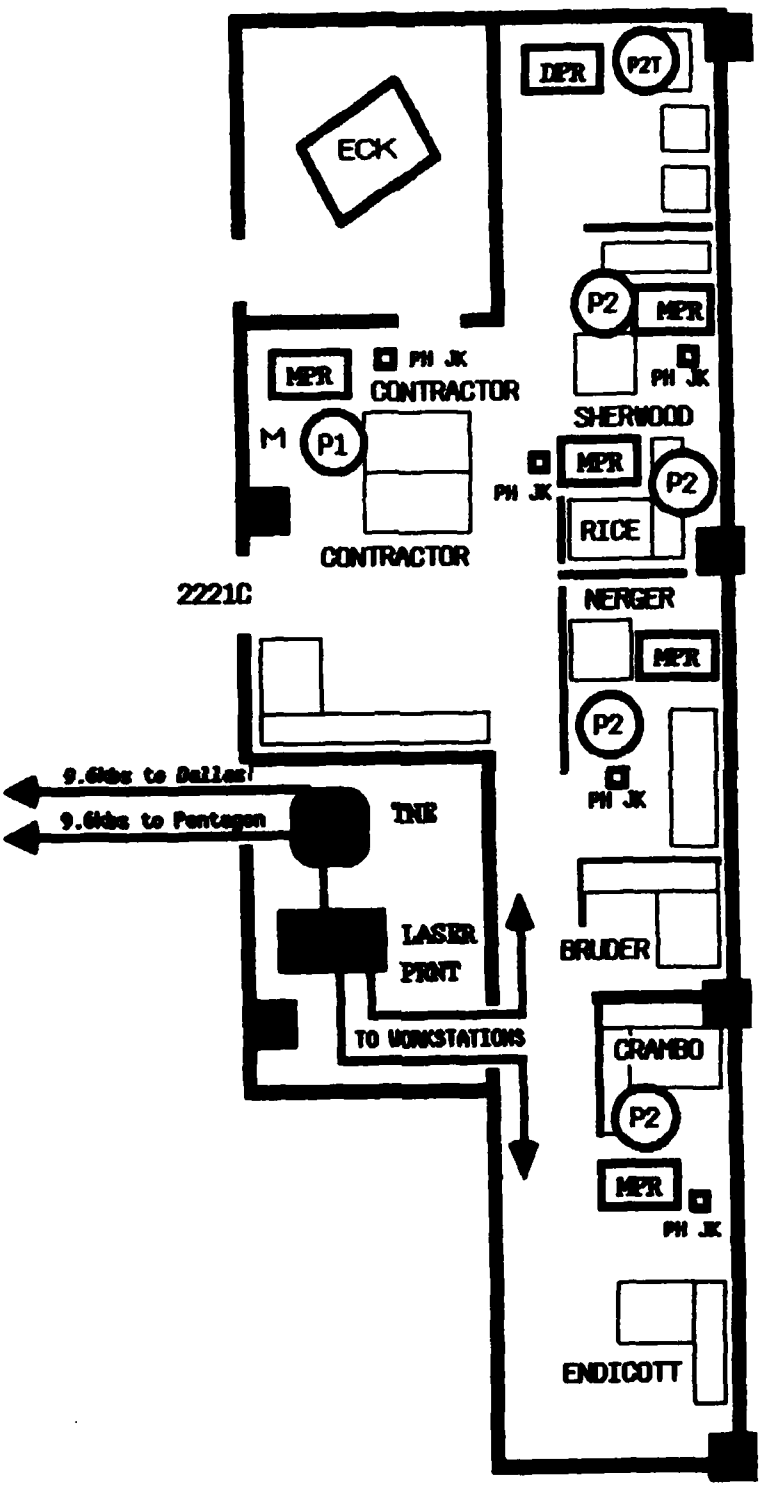

Figure C6. DAEN-ZCP-M/MA workstation layout.

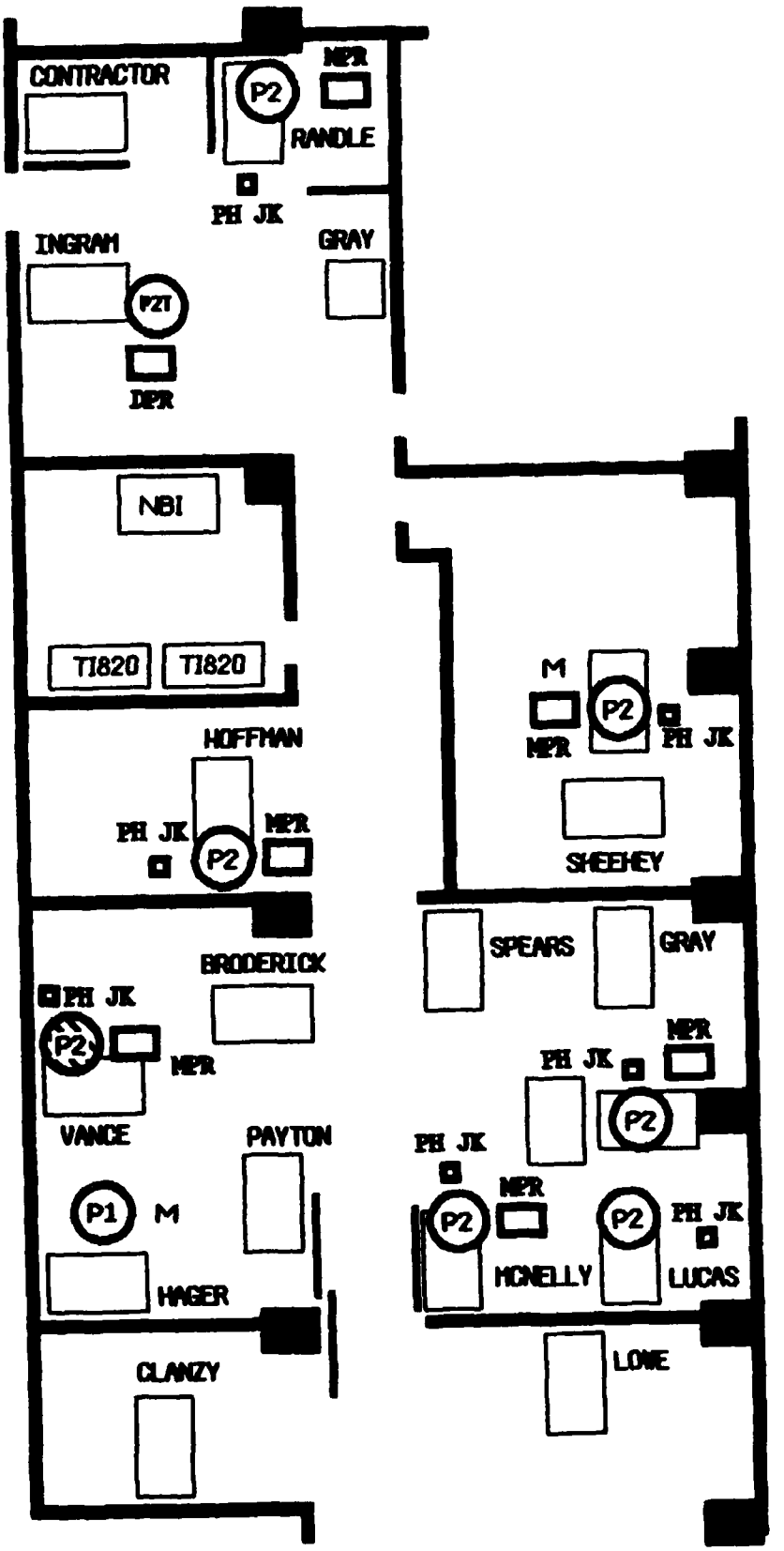

Figure C7. DAEN-ZCP-M/MB workstation layout.

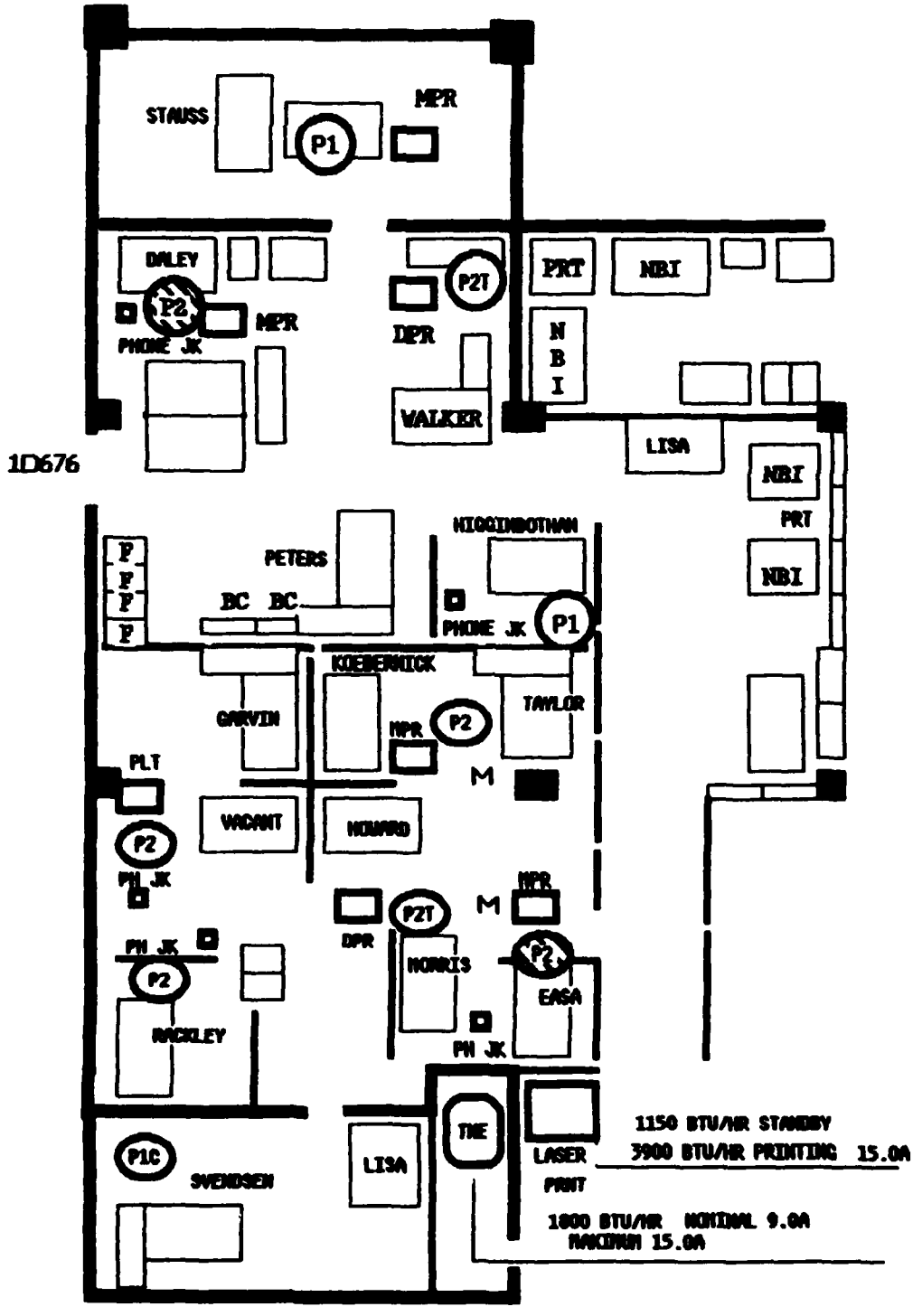

Figure C8. DAEN-ZCP-U/ZCR workstation layout.

APPENDIX D:

OACE SYSTEM COST SUMMARY

Table D1

System Configuration and Cost Summary

DIV	PC	PC-XT	B/W CRT	COL CRT	MAT PRT	M PRNT SUPPL	DSY PRT	D PRNT SUPPL	ASYNC CARD	SPR V CARD	64K CHIPS	BB 2+ CARD	LR RAM CARD
COST	2304	4371.25	302.50	808.75	1000	90.00	2136.50	94.50	105	497.5	56.25	1075	300
ZCZ-A	4	2	5	1	3	1	1	1	1	5	16	2	2
TOT	9216	8742.50	1512.50	808.75	3000	90.00	2136.50	94.50	105	2487.5	900	2150	600
ZCA	2	1	3	0	1	1	1	1	0	3	8	1	1
TOT	4608	4371.25	907.50	0.0	1000	90.00	2136.50	94.50	0.0	1492.50	450.00	1075.00	300.00
ZCE	6	2	8	0	3	1	2	1	2	8	21	3	3
TOT	13824	8742.50	2420.00	0.0	3000	90.00	4273.00	94.50	210	3980	1181.25	3225	900
ZCF	1	1	2	0	1	1	1	1	1	2	5	1	1
TOT	2304	4371.25	605.00	0.0	1000	90.00	2136.50	94.50	105	995	281.25	1075	300
ZCH												10	10
TOT												10750	3000
ZCI	1	4	5	0	2	1	2	1	0	5	11	2	2
TOT	2304	17485.00	1512.50	0.0	2000	90.00	4273.00	94.50	0	2487.5	618.75	2150	600
ZCM	4	4	8	0	4	1	1	1	3	8	20	4	4
TOT	9216	17485.00	2420.00	0.0	4000	90.00	2136.50	94.50	315	3980	1125	4300	1200
ZCP	1	2	3	0	1	1	2	1	1	3	7	1	1
TOT	2304	8742.50	907.50	0.0	1000	90.00	4273.00	94.50	105	1492.5	393.75	1075	300
ZCP-C	3	1	3	1	2	1	1	1	1	4	11	1	1
TOT	6912	4371.25	907.50	808.75	2000	90.00	2136.50	94.50	105	1990	618.75	1075	300
ZCP-M		4	4	0	0	0	1	1	0	4	8	1	1
TOT	0	17485.00	1210.00	0.0	0	0.0	2136.50	94.50	0	1990	450	1075	300
ZCP-MA & MB	2	4	5	1	2	1	2	1	0	6	20	2	2
TOT	4608	17485.00	1512.50	808.75	2000	90.00	4273.00	94.50	0	2985	1125	2150	600
ZCP-R	4	3	1	1	3	1	1	1	2	6	18	3	3
TOT	9216	13113.75	302.50	808.75	3000	90.00	2136.50	94.50	210	2985	1012.5	3225	900
ZCP-U	2	2	4	0	2	1	1	1	1	4	6	1	1
COST	4608	8742.50	1210.00	0.0	2000	90.00	2136.50	94.50	105	1990	337.5	1075	300
ZCR	1	5	5	1	2	1	1	1	0	5	13	3	3
TOT	2304	21856.25	1512.50	808.75	2000	90.00	2136.50	94.50	0	2487.5	731.25	3225	900

Table D1 (Cont'd)

LAN CARD	LAN KIT	LAN CABLE	"T" CONN	POP	MOD	PLOT-TER	COLOR PRNT	STAND SOFTW	PC FOCUS	LASER PRNT	HDWR TOT $	DIV
434.38	931.25	3.75	6.25	3154	500	1690	2045	1319.26	1595	16145		COST
4	1	144	4	1	2	0	0	1	1	0		ZCZ-A
1737.52	931.25	540	25	3154	1000	0	0	1319.26	1595	0	$ 42145.28	TOT
1	1	50	1			0	0	1	0	0		ZCA
434.38	931.25	187.50	6.25	0.0	0.0	0.0	0.0	1319.26	0.0	0.0	19403.89	TOT
6	1	100	6	1	3	0	0	1	1	0		ZCE
2606.28	931.25	375	37.5	3154	1500	0	0	1319.26	1595	0	$ 53458.54	TOT
0	1	30	0	0	1	0	0	1	1	0		ZCF
0	931.25	112.5	0	0	500	0	0	1319.26	1595		$ 17815.51	TOT
13	2	200	13	0	0	0	0	1	0	1		ZCH
5646.94	1862.5	750	81.25					1319.26		16145	$ 39554.95	TOT
3	1	100	3	0	2	1	0	1	1	0		ZCI
1303.14	931.25	375	18.75	0	1000	1690	0	1319.26	1595	0	$ 41847.65	TOT
6	1	150	6	0	3	0	0	1	1	0		ZCM
2606.28	931.25	562.5	37.5	0	1500	0	0	1319.26	1595	0	$ 54913.79	TOT
1	1	50	1	0	0	1	1	1	1	0		ZCP
434.38	931.25	187.5	6.25	0	0	1690	2045	1319.26	1595	0	$ 28986.39	TOT
2	1	50	2	1	1	0	0	1	1	0		ZCP-C
868.76	931.25	187.5	12.5	3154	500	0	0	1319.26	1595	0	$ 29977.52	TOT
4	1	70	6	1	1	1	0	1	3	0		ZCP-M
1737.52	931.25	262.5	37.5	3154	500	1690	0	1319.26	4785	0	$ 39158.03	TOT
6	2	170	6	1	2	0	0	2	4	0		ZCP-MA & MB
2606.28	1862.5	637.5	37.5	3154	0	0	0	2638.52	6380	0	$ 55048.05	TOT
5	1	120	5	0	2	0	0	1	1	0		ZCP-R
2171.9	931.25	450	31.25	0	1000	0	0	1319.26	1595	0	$ 44593.16	TOT
2	1	50	2	0	1	0	0	1	1	0		ZCP-U
868.76	931.25	187.5	12.5	0	500	0	0	1319.26	1595	0	$ 28103.27	COST
4	1	50	4	2	2	0	0	1	1	1		ZCR
1737.52	931.25	187.5	25	6308	1000	0	0	1319.26	1595	16145	$ 67394.78	TOT
											$ 520255.53	

Table D2

System Installation Cost Summary

DIV	INSTALL PC	INSTALL PC-XT	INSTALL M PRNT	INSTALL D PRNT	INSTALL LAN	INSTALL TOT
COST	215.00	195.00	112.50	250.00	100.00	
ZCZ-A	4	2	3	1	6	
TOT	860.00	390.00	337.50	250.00	600.00	2437.50
ZCA	2	1	1	1	3	
TOT	430.00	195.00	112.50	250.00	300.00	1287.50
ZCE	6	2	3	2	8	
TOT	1290.00	390.00	337.50	500.00	800.00	3317.50
ZCF	1	1	1	1	2	
TOT	215.00	195.00	112.50	250.00	200.00	972.50
ZCH					13	
TOT	0.0	0.0	0.0	0.0	1300.00	1300.00
ZCI	1	4	2	2	5	
TOT	215.00	780.00	225.00	500.00	500.00	2220.00
ZCM	4	4	4	1	8	
TOT	860.00	780.00	450.00	250.00	800.00	3140.00
ZCP	1	2	1	2	3	
TOT	215.00	390.00	112.50	500.00	300.00	1517.50
ZCP-C	3	1	2	1	4	
TOT	645.00	195.00	225.00	250.00	400.00	1715.00
ZCP-M	0	4	0	1	4	
TOT	0.0	780.00	0.0	250.00	400.00	1430.00
ZCP-MA & MB	2	4	2	2	10	
TOT	430.00	780.00	225.00	500.00	1000.00	2935.00
ZCP-R	4	3	3	1	7	
TOT	860.00	585.00	337.50	250.00	700.00	2732.50
ZCP-U	2	2	3	1	4	
TOT	430.00	390.00	337.50	250.00	400.00	1807.50
ZCR	1	5	2	1	6	
TOT	215.00	975.00	225.00	250.00	600.00	2265.00
					TOTAL	29077.50

Table D3

System Maintenance Cost Summary

NINE MONTH PERIOD

DIV/	PC MAINT	PC-XT MAINT	MATRIX MAINT	DAISY MAINT	LAN MAINT	TOT
COST	314.10	475.65	225.00	369.00	162.00	
ZCZ-A	4	2	3	1	6	
TOT	1256.40	951.30	675.00	369.00	972.00	4223.70
ZCA	2	1	1	1	3	
TOT	628.20	475.65	225.00	369.00	486.00	2183.85
ZCE	6	2	3	2	8	
TOT	1884.60	951.30	675.00	738.00	1296.00	5544.90
ZCF	1	1	1	1	2	
TOT	314.10	475.65	225.00	369.00	324.00	1707.75
ZCH					13	
TOT	0.0	0.0	0.0	0.0	2106.00	2106.00
ZCI	1	4	2	2	5	
TOT	314.10	1902.60	450.00	738.00	810.00	4214.70
ZCM	4	4	4	1	8	
TOT	1256.40	1902.60	900.00	369.00	1296.00	5724.00
ZCP	1	2	1	2	3	
TOT	314.10	951.30	225.00	738.00	486.00	2714.40
ZCP-C	3	1	2	1	4	
TOT	942.30	475.65	450.00	369.00	648.00	2884.95
ZCP-M	0	4	0	1	4	
TOT	0.0	1902.60	0.0	369.00	648.00	2919.60
ZCP-MA/MB	2	4	2	2	10	
TOT	628.20	1902.60	450.00	738.00	1620.00	5338.80
ZCP-R	4	3	3	1	7	
TOT	1256.40	1426.95	675.00	369.00	1134.00	4861.35
ZCP-U	2	2	3	1	4	
TOT	628.20	951.30	675.00	369.00	648.00	3271.50
ZCR	1	5	2	1	6	
TOT	314.10	2378.25	450.00	369.00	972.00	4483.35
TOT EQUIP	31	35	27	17	83	
TOTAL $						52178.85

APPENDIX E:

SAMPLE APPENDIX I OF TB 18-100

A Technical Bulletin (TB) 18-100 Appendix I must be prepared to requisition professional workstations (personal computers).* The example in this appendix shows the type of information required in these documents.

*Technical Bulletin (TB) 18-100, Army Automation Life Cycle Management (U.S. Department of the Army, 5 August 1981).

APPENDIX I

NONCOMPETITIVE ACQUISITION OF AUTOMATED DATA PROCESSING SYSTEMS OR AUTOMATED DATA PROCESSING EQUIPMENT

SECTION I - IDENTIFICATION

1. Assigned Responsible Agency. Construction Programming Division, USACE (DAEN-ZCP).

2. Title and Number of Data Processing Installation/Agency. Office of the Assistant Chief of Engineers.

3. Requiring Activity Representative. LT Steven D. Friederich, RPMS Integration and Planning Office (DAEN-ZCR).

SECTION II - ADP SYSTEM OR ADPE REQUIRED

4. Description of Requested System or ADPE.

HARDWARE

Qty	Part No.	Item/Description	GSA Price	Est Total	Yearly Maint.
6	5160087	Basic System - IBM PC/XT, 128K RAM, Keyboard, 1-360K Floppy Disk Drive, 1-10Mb Fixed Hard Disk, with Adaptors and Async	$4,196.	$25,176.	3,420.
6	5151001	Monochrome CRT	387.	2,322.	342.
6	FX-100	Printer, Matrix 160 cps	872.	5,232.	1,188.
6	1525612	Printer Cable	46.	276.	---
6	1525614	Printer Stand	46.	276.	---
6	1504900	Monochrome/Printer Adapter Card	235.	1,410.	400.
6	1501003	256K RAM Expansion Board	137.	822.	476..
6	1200B	Hayse Smart Modem Card	498.	2,988.	687.
		Delivery Charges		15.	
		Total		$38,517.	$6,513.

SOFTWARE

Qty	Part No.	Item/Description	GSA Price	Est Total
3	6024035	CP/M 86	$ 185.	$ 555.
	6025010	BASIC	INCL	INCL
3	6024061	IBM DOS	47.	141.
3		Select with Super Spell	458.	1,374.
3		Supercalc 2	228.	684.
3		Lotus 1,2,3	382.	1,146.
		Total		$3,900.

5. Source Evaluation and Selection.

The IBM PC and the PC/XT microcomputers (micros) were selected for the following reasons: (1) compatibility, (2) ready availability of third party hardware, software, and maintenance, (3) superior communications capability, and (4) availability of special applications development support. Many microcomputers were evaluated; four met the requirements to some degree. However, a comparison clearly indicated IBM is the only micro that meets all the requirements.

Hardware application and software technology are the essential elements for choosing the proper micro. The IBM is compatible and will integrate with current OACE systems, i.e., CAPCES and the DD Form 1391 Processor; it also has the flexibility to be compatible with future ADP systems such as VIABLE, STAMMIS, HOMES, and HIOS. Third-party support is extremely important and is currently proliferating with IBM. Well known, established companies such as Tymshare and 3Com are supporting communications capability. Special emulation software developed specifically for the PC/XT allows the IBM to communicate with many different types of mainframes and minicomputers.

SECTION III - JUSTIFICATION

6. Hardware.

There are a number of reasons for DAEN-ZCP's decision to acquire an automated task support system and an IBM PC/XT. The justification (see Table 8 in text) can be summarized as: (1) the high ratio of processing power to cost, (2) labor saving potential or cost avoidance, (3) quality and timeliness of data output, and (4) the ability to minimize expensive local and remote mainframe connect time.

7. Software.

Microcomputer-based software is now comparable to minicomputer/mainframe software. Much more work can be done locally in a stand-alone mode. All work formerly was done at terminals hooked up to a mainframe in the old "star" configuration. This was very costly concerning software development, and relatively inefficient compared to operating locally on micros. Access to mainframes is still needed in a micro environment for support, but, an on-site mainframe is not necessary. Remote access can be used to send needed information to the workstation. Another important item to consider is the availability of former mainframe software in a micro version, e.g., SEED, IDMS, and FOCUS.

8. MILCON Management Branch (ZCP-M).

ZCP-M will need six systems, from which the following benefits are anticipated.

a. Cost displacement (reduction or avoidance). ZCP-M reviews and analyzes MILCON financial performance and develops as well as manages the OCE automated construction support system, i.e., CAPCES and DD Form 1391 Processor. This branch is highly labor-intensive due to the enormous amount of data created and used. ZCP-M is operating with four unintelligent terminals, each running 10 to 12 hours a day online. The new system will allow ZCP-M to do much of the work offline, speeding the process greatly. The time spent on each task could be reduced by as much as 50 percent, and connect-time charges are reduced by using intelligent terminals.

b. Value added. Addition of the IBM PC/XTs will allow ZCP-M to dedicate more time to improving the current automated support systems and creating new applications using existing data. The result would be better planning and budgeting of the MCA and other Army construction. Major impacts will be a savings of construction dollars, faster response to budget changes, and a higher quality of data to be used by other branches and divisions within the Corps, for Army Staff, and engineers throughout the Army.

c. New capabilities. Intelligent terminals will give ZCP-M the ability to download data from a remote host, edit the data offline, and upload the correct files in considerably less time than doing all the work online. The ability to print data while using the terminal will shorten the time connected to the remote host.

9. Funds are available.

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Office automation: Office of the Assistant Chief of Engineers / by Roger L. Lapp ... et al.) -- Champaign, Ill : Construction Engineering Research Laboratory, 1984.
85 p. (Technical report ; P-167)

1. Office practice--automation. 2. U.S. Army Corps of Engineers Office of the Assistant Chief of Engineers. I. Lapp, Roger L. II. Friederich, Steven D. III. Baskin, Arthur B. IV. Randle, Janet R. V. Mabry, Frank J. VI. Kim, Simon S. VII. Moore, Alan W. VIII. Series: Technical report (Construction Engineering Research Laboratory) ; P-167.

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